University of Bath

PHD

Patient medication records by community pharmacy

Rogers, Philip John

Award date:
1993

Awarding institution:
University of Bath

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Download date: 13. May. 2019

PATIENT MEDICATION RECORDS IN COMMUNITY PHARMACY

submitted by PHILIP JOHN ROGERS

for the degree of PhD

1993

COPYRIGHT

Attention is drawn to the fact that copyright of this thesis rests with its author. The copy of this thesis has been supplied on condition that anyone who consults it is understood to recognise that its copyright rests with its author and that no quotation from the thesis and no information derived from it may be published without the prior written consent of the author.

This thesis may be available for consultation within the University Library and may be photocopied or lent to other libraries for the purposes of consultation.

Philip J Rogers

1/12/93

UMI Number: U054705

All rights reserved

INFORMATION TO ALL USERS
The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript
and there are missing pages, these will be noted. Also, if material had to be removed,
a note will indicate the deletion.

UMI U054705
Published by ProQuest LLC 2013. Copyright in the Dissertation held by the Author.
Microform Edition © ProQuest LLC.
All rights reserved. This work is protected against
unauthorized copying under Title 17, United States Code.

ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346

UNIVERSITY OF BATH
LIBRARY
23. 11 MAY 1994
PHD
5079642

Summary

Since the 1970's community pharmacists in the UK increasingly have maintained patient medication records (PMRs). The aim of this project is to assess the impact of PMRs on community pharmacy practice in England and Wales. Using a postal survey, this study has shown the extent to which PMRs are used in community pharmacy practice, with particular reference to the recording of patient and product details. A further study, by means of an audit of all patients' clinical conditions in a PMR system in one community pharmacy, has compared data from the PMR system with national morbidity statistics; this is a method that community pharmacists could use to develop patient services. A separate investigation of community pharmacists' motives for purchasing PMR systems showed that community pharmacists maintain PMRs primarily to provide improved clinical services to their patients, rather than for commercial reasons or for financial reward.

A postal survey of general practitioners (GPs) showed a majority in support of pharmacy-held PMRs, but little support for PMR retention by Family Health Service Authorities. GPs also supported the use of patient information leaflets in conjunction with PMR systems. The readability of such leaflets has been compared with original pack inserts using computer analysis. Patient information leaflets were shown to have no effect on the compliance of a group of patients receiving antibiotic therapy.

A multi-centre study showed important benefits of pharmacists using PMRs to monitor a patient's therapy for potential drug interactions, contraindicated products, incorrectly-prescribed medication, and incorrectly-prescribed doses. The survey identified that PMRs are of particular benefit in monitoring for potential drug interactions between previously-dispensed and newly-prescribed medication. The nature of interventions made by community pharmacists demonstrated a particular need to maintain records for those patients with cardio-vascular disease, asthmatics, diabetics and the young.

An analysis of potential drug interactions reported by community pharmacists showed considerable inconsistency between five PMR systems in their ability to detect drug interactions. Reasons for the inadequate performance of some systems are described, and recommendations are made for their improvement. Further recommendations are that community pharmacists must have access to patient medication histories, and information about a patient's clinical condition in which medication may be contraindicated.

Acknowledgements

The author wishes to acknowledge several individuals and organisations, without whose support this research would not have been possible. First, I would wish to thank Boots the Chemists Ltd. for their assistance, through their funding of my post as a Teacher-practitioner at the School of Pharmacy and Pharmacology, and for the provision of computer equipment used for data analysis. Second, I wish to thank Hadley Hutt Computing Ltd. for their research grant covering the considerable postage and consumables costs of the project. The survey of general practitioners was funded with support from Devon Family Health Services Authority.

During the conduct of the project, we have also been supported by the following companies who provided computer hardware and/or software: John Richardson Computers Ltd.; Park Systems Ltd.; Chemtec Systems Ltd.; AAH PLC; and Exeter Data Base Systems Ltd.

I am grateful to my supervisors, Professor John Rees and George Fletcher, for their support and advice over the past three and a half years. I am especially appreciative of George Fletcher's continued support and encouragement over the last year in spite of his serious illness.

I wish to thank Mrs Susan Johnson for her secretarial support, my wife Sue and the following members of the School's staff for their assistance in packing, sorting and questionnaire coding: Mrs Sandra Wood, Christopher Coy, Mrs Doreen Vinecombe, and Mrs Julie Woodman.

I am appreciative of the information provided by Mrs Anne Prasad, on the inclusion of drug interaction information in the British National Formulary; and by the Department of Health on National Health Service prescription numbers. Assistance was provided by Miss Rosemary Moffatt and Anthony Allen by allowing us to use their pharmacies

for a study on the effect of patient information leaflets on compliance. Support for a survey of general practitioners in Avon was given by Avon Local Medical Committee. Over 1000 community pharmacists and over 800 general practitioners provided responses to postal questionnaires; I am most appreciative of this considerable demonstration of goodwill.

Finally, I would like to thank my wife Sue for her constant support during the conduct of this research and the writing of this thesis.

Contents

Tables and Figures

List of Tables

Chapter 2

Chapter 6

Chapter 7

List of Figures

Chapter 1

Chapter 2

Abbreviations Used Within the Text

ABPI	Association of British Pharmaceutical Industry
ACE	angiotensin-converting enzyme
ADR	adverse drug reaction
APhA	American Pharmaceutical Association
BNF	British National Formulary
DTSS	Drug Therapy Screening System
EEC	European Economic Community
EDI	Evaluations of Drug Interactions
EEPROM	electronically erasable read-only memory
FHSA	Family Health Services Authority
GP	General practitioner
GTN	glyceryl trinitrate
HRT	hormone replacement therapy
ICD	International classification of diseases
JRC	John Richardson Computers
NHS	National Health Service
NPA	National Pharmaceutical Association
NSAIDs	non-steroidal anti-inflammatory drugs
OTC	over the counter (ie. non-prescription)
PC	personal computer
Plc	public limited company
PMR	patient medication record
PPA	Prescription Pricing Authority
PROM	programmable read only memory
RPSGB	Royal Pharmaceutical Society of Great Britain
SEG	socio-economic group
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
USA	United States of America

1 Introduction

1.1 Community Pharmacy in the United Kingdom

Pharmacy is both the science of the research, development and production of medicines, and the profession of those individuals involved in the supply of medicinal products to patients and the general public. In order to be a member of the pharmaceutical profession in the United Kingdom (UK), individuals must be registered as a pharmaceutical chemist (pharmacist) with the Royal Pharmaceutical Society of Great Britain (RPSGB). In the UK, the majority of pharmacists practice their profession in community pharmacy, while others are engaged in hospital practice, in the pharmaceutical industry or in academia.

The typical community pharmacy has been described as the shop in the high street where prescriptions are dispensed and medicines sold.[1] At present, there are about 12 000 such pharmacies in the UK, representing about one for every 5 000 members of the public. Premises to be used as a pharmacy must be registered with the RPSGB. The main legal requirements for pharmacies in the UK are derived from the Medicines Act 1968. In particular, the Medicines Act 1968 sets out in detail how medicines may be sold or supplied. Legislation categorises General Sales List (GSL) medicines which are considered safe to be sold anywhere and Prescription Only Medicines (POM) which pharmacists may only supply on the written order of a registered medical or dental practitioner. The remaining medicines, known as Pharmacy (P) medicines, are not listed and can only be sold by or under the supervision of a pharmacist from a registered pharmacy.

Dispensing under the National Health Service (NHS) is carried out under a contract between the owner of the pharmacy, who need not be a pharmacist, and the local Family Health Service Authority (FHSA). Under the National Health Service Act 1977, dispensing is required to be carried out normally under the supervision of a

pharmacist. However in some rural districts general practitioners (GPs) dispense for their patients. This arrangement has led to disputes between the medical and pharmaceutical professions.

The community pharmacy draws its pharmaceutical income from three sources: firstly from the NHS contract to dispense; secondly from the dispensing of private prescriptions; and thirdly from the sale of medicines and other health care related products. In addition, in contrast with pharmacies in many other European countries, income is also generated from the sale of non-pharmaceutical products, eg. cosmetics and toiletries, photographic requisites and other leisure goods. This is especially so in those pharmacies owned by large multiple companies.

1.2 Development of Patient Medication Records

In its simplest form, a patient medication record can be considered as a record containing a patient's details and the details of pharmaceutical products supplied to that individual patient. Such a record need contain no more than sufficient information to identify the patient, ie. their name and address, and the names of products supplied to them. In practice, there is the potential to record more product detail, eg. the form, strength and prescribed dose of supplied products, together with information about the source of a product, eg supplier and batch number. There is also the scope to record a considerable amount of clinical and administrative information about the patient, for example, clinical conditions, drug allergies and NHS numbers.

Pharmacists are not, as yet, legally or professionally bound to keep PMRs, despite a long-standing tradition of keeping records for various purposes in community pharmacy. Under the Medicines Act 1968, pharmacists are required to keep records of dispensed private (non-NHS) prescriptions, and under the Misuse of Drugs Act 1971

and its regulations 1985, pharmacists are required to keep records of the supply of all Schedule 2 (CD Register) Controlled Drugs.

1.2.1 Manual Records

Dalglish used one of the first systems recorded.[2] He maintained an alphabetical card index of patients, recording the name and address of the patient with the name, form and strength of medicines dispensed, and the date on which medicines were dispensed. He also had the facility within his card-index file to record drug allergies, for example to penicillins. He identified the main benefit of his system as being able to label dispensed medicines with full directions rather than "as directed". Although he considered his system to be very time-consuming; nevertheless he concluded that the benefits of his system, through the need for less time spent in contacting doctors, outweighed the inconvenience of the time taken to update his records. Dalglish argued that the use of PMRs would lead to pharmacists being accepted as "professional men and women and not just another high street trader."

Balmford described a system whereby he kept card records for elderly and chronically-sick patients.[3] He used a colour-coded system to record special circumstances, for example: penicillin hypersensitivity. In addition, he described the use of his card system to record details about supply of appliances, eg. insulin needle sizes, and elastic hosiery particulars. Balmford believed that he increased patient confidence through keeping medication records.

O'Hara described the use of "patient medication profiles" in the USA.[4] In this paper, he outlined the changes taking place in 1976 in community practice in the USA, and the changes being implemented in American pharmaceutical education at that time to accommodate those changes. In particular, he emphasised that the pharmacist's responsibility to the patient extended beyond the accurate filling of prescribed

medication orders (i.e. the dispensing of prescriptions), and that clinical components were being introduced to undergraduate curricula to prepare students for their future role. O'Hara described the intent of the patient medication profile as to consolidate pertinent facts relating to a patient's drug therapy, eg. name, age, sex, weight, height, allergies or drug sensitivities and all chronic disease conditions, plus all details of prescription and OTC (over-the-counter) medications being used.

The economics of maintaining PMRs was first assessed in 1977 by workers at the School of Pharmacy, University of Bradford.[5] They estimated that keeping a simple card system would take 18 hours per week: this agreed with Dalglish's estimate of the effect on time costs.[2] They concluded that the maintenance PMRs could not be justified on commercial grounds alone.

Shulman and Shulman described a two-card system that could be used to monitor patient medication and provide a method of recording data that all health-care professions could access.[6] Every patient was given a card containing his name and address which could be presented to all health professionals. The card was presented at pharmacies, so that details of medicines dispensed or purchased could be written on the card. A second card was held at Shulman's pharmacy which contained the above information, along with the name of the patient's general practitioner and details of any chronic conditions from which the patient was suffering. Any change in the strength or dose of long term treatment was indicated by a colour change on the card. In their paper they emphasised the benefits to patients of PMR use, including the ability to detect prescription errors including non-intentional changes of dose. Two important issues were raised by the authors of this important paper. They described how their use of a PMR system led to an increased time spent in monitoring for potential drug-related problems, and in patient counselling. They argued that the cost reimbursement of the pharmacist for the increased workload could be met as a result of the reduction in iatrogenic disease achieved by PMR use. In this context, the point was made that

future negotiations on the payment for pharmaceutical services should address the issue of funding the pharmacist's altered role. The second issue addressed in the paper was that of the professional relationship between doctor and pharmacist. The authors described a reluctance on the part of some doctors to alter prescriptions on the pharmacist's advice, thus putting the patient at risk. These doctors could not accept that pharmacists were acting professionally, in the patient's interest, rather than for their own commercial advantage.

Shulman and Shulman went on to show that their two card system enabled them to detect potential drug interactions between medicines they dispensed for their patients and those which were obtained from other sources, eg. hospital pharmacies, describing the potential benefits to the population of fewer major adverse drug reactions.[7]

1.2.2 The Computerisation of Community Pharmacy

Computerisation of pharmacy in the USA took place about five years earlier than in the UK. In 1974, Karig *et al* described the exposure of pharmacy undergraduate students to a computerised PMR system as part of their clinical pharmacy course.[8] The late 1970's saw the dawn of computerisation of community pharmacy in the UK. Unichem developed a keypad system in 1978, called *Prosper* (Prosper Rebate Orientation, Sales Planning and Evaluation Routine) to simplify ordering and stock control.[9] This was followed in 1979 by the *Pride* system (Prescription Records In Dispensing Environment), which enabled pharmacists to produce labels and maintain a record of dispensed medication.[10] *Pride* was the first available patient medication record system using a computer to store records. Also, at this time Winters described the use of pharmacy computers in "drug surveillance" in Holland[11]

In the UK, concerns about the impact of computers on the future of the profession were expressed at this time. For example, a report of a working party set up by the

Pharmaceutical Society was received by the Society's Council in December 1979.[10] Two controversial issues were raised in the report; these were confidentiality and patient registration. The issue of confidentiality was to be fully addressed in 1984 by the Data Protection Act 1984,[12] whereas the issue of patient registration has not yet been resolved. Problems associated with the lack of patient registration in community pharmacy have been described by Stevens in a review article on the development of PMRs in the UK.[13] The argument was made that without full patient registration, pharmacy-maintained PMRs would be at best incomplete, and at worst pointless.

The Pharmaceutical Society working party concluded that PMRs would benefit the community pharmacist, by giving him more time to spend with patients, and would enhance professionalism by making him better informed. The advantage of using computers to reinforce the pharmacist as a source of information on medicines was discussed by Teeling-Smith in an address to the College of Pharmacy Practice.[14] He argued that pharmacy could be on the verge of a "golden age" underpinned by a second pharmacological revolution and the concept of self-care. These would be enhanced by professional developments and the use of computers to manage information. At the 13th European Symposium on Clinical Pharmacy in 1984 Brian Hartley, then the deputy chief pharmacist at the Department of Health forecast that community pharmacists would have a computer network enabling them to exchange medication data and keep track of Controlled Drug users.[15] Also in 1984, Lutz predicted that computers would profoundly affect the quality, style and methods of health care delivery in the United States.[16] The requirements for pharmacy computer systems in the USA were described by McKay.[17] He described these requirements under three groups of functions: patient care functions, dispensing computer systems functions, and those files required to compose a working database.

The use of computers increased throughout the 1980s. An American study demonstrated the time saving advantages in using a computer to produce dispensing

labels.[18] However, another paper published by Berger at about the same time detailed how, in the USA, pharmacy computer systems were not increasing efficiency.[19]

A milestone was reached in the UK in January 1984 when it became a requirement to have machine-printed labels on dispensed medicines. At this point several labelling systems were available from different suppliers using programmable electronic typewriters and 8-bit computers as hardware. Most computers used either a cassette tape or floppy disks to hold programs and data. Stevens and Crabbe published the results of a survey of all pharmacies on the NPA's mailing list (approximately 10 000) which showed that as well as for labelling products, 20% of respondents were using a computer for drug interaction monitoring and 4.9% of respondents maintained patient records.[20] However the authors of that paper had a response rate of less than 9% to their questionnaire, and the figures published could be a gross over-estimate of the clinical use of pharmacy computer systems in the mid 1980s.

In the late 1980s, 8-bit computers including the BBC micro were superseded in practice by more powerful 16-bit computers based on the IBM PC.[12] These computers had fixed hard disks capable of holding around 40Mb of programs and data, that is, approximately 100 times greater capacity than a single floppy disk. Several companies marketing PMR systems emerged at this stage and 13 suppliers were listed in a review article.[21] These companies were: Vestric, Talk Data Computer Systems, John Richardson Computers, Image Micro Systems, Park Systems, Channel Business Systems, Rombus Computers Ltd, Bracey's Pharmacy, Mike Hadley, Pharmaceutical Computer Systems, Graham Tatford, Mawdsley-Brooks and IDC Computer Systems.

The Nuffield inquiry's report *Pharmacy: A report to the Nuffield Foundation*[1] highlighted the benefits of medication records, particularly electronic ones, in checking for drug interactions and monitoring therapy.[22] This role was recognised by the Government in the White Paper *Promoting Better Health*[23], in which it was proposed

to introduce an allowance payable to those pharmacies maintaining a substantial number of records relating to elderly or confused patients on long term medication. Payments commenced to pharmacist contractors for this service in the latter half of 1989. The extent to which these payments have influenced the use of PMR systems by pharmacists is described in Chapter 3. More recently the Report of the Joint Working Party on the Future Role of Community Pharmacy Services *Pharmaceutical Care: The Future for Community Pharmacy* recommended that "all pharmacists should maintain patient medication records where they believe it will be of benefit to the patient to do so."[24]

The RPSGB published its guidelines on the use of pharmacy computer systems in March 1989. These were grouped under general points, labelling systems and patient medication records. The general points included the recommendation of IBM PC compatible hardware, with a minimum 32Mb hard disk and a tape streamer backup. All data relating to patients were recommended to be password protected to preserve confidentiality. Recommendations on labelling systems included the use of British National Formulary cautionary labels, and the highlighting of the two highest levels of interaction on the Stockley system.[25] A unique number should be given to each prescription to help produce an audit trail for use, for example, in a case of litigation. Several recommendations were made on the maintenance of computerised patient records. These included the data to be recorded in the record, which were: name, address including postcode, National Health Service number, sex, date of birth, telephone number, name of GP, drug sensitivities, allergies, chronic conditions and medicines purchased. A hard copy of records was required to be made available to patients to comply with the Data Protection Act 1984. It was also recommended that archived records were kept for 10 years for the purposes of the Consumer Protection Act 1987.

Boakes *et al* published a landmark paper in 1990.[26] That paper described the general state of the use of computer systems at the end of the 1980's. They found that computers were used in 95% of the pharmacies taking part in their survey. Computerised drug interaction monitoring was used by 30% of the respondents, and PMRs by 25%. However, PMR use was favoured by 82% of those responding.

1.2.3 Drug Interaction Monitoring Software

One major feature of computerised PMR systems is that they can monitor for drug interactions between drugs dispensed over a variable period of time. Strickland-Hodge summarised the criteria essential for an effective drug interaction system.[27] These included that, if required, the searching period for interactions should extend to two years; and that the drug interaction information should be obtained from a reputable source and be regularly updated in electronic form. Systems should be able to recognise both generic and proprietary drug names and identify individual drug constituents within compound preparations. The clinical use of drug interaction software has been researched and reported by Stevens and Crabbe.[28] In that paper they described the nature of all potential drug interactions detected by a PMR system with drug interaction monitoring software over a one-month period. In particular Stevens and Crabbe highlighted drug interactions with potentially very serious consequences for patients.

1.2.4 Examples of Computer Systems Available at the End of the 1980's

Strickland-Hodge reviewed five examples of PMR systems.[29] These represented the three systems in greatest use, along with two innovative systems with novel features. A brief description of these five systems is given below.

The John Richardson Computers system at that time used a Sanyo IBM-compatible computer. The system could hold 32 000 patient records and 200 000 individual

prescriptions. The system recorded patients' names, addresses and telephone numbers; their age, sex and drug allergies; and their doctor's name. A drug interaction facility was incorporated, developed in conjunction with Dr Ivan Stockley. The system offered an ordering facility from a choice of wholesalers.

Park Systems had an IBM-compatible based system which featured a drug interaction program, providing on-screen details about the nature of the interaction. This system recorded patient allergies, sensitivities and conditions. In some conditions, this information interacted with the drug database to warn the pharmacist about contraindicated drugs, for example displaying a warning if the pharmacist dispensed non-cardioselective β-blockers for a patient previously recorded as asthmatic.

AAH offered a system that was IBM-compatible, and had a patient record database, the size of which was limited only by hard disk capacity. This system featured a tape streamer for data backup. The program had a drug interaction monitoring facility and the *Philex* (Pharmaceutical Industry Lexicon) product database.[30]

Hadley Hutt Computing Ltd. produced an innovative computer system. A novel feature of the program was that it could produce a patient information leaflet on a second printer at the time of label production. Some advantages of this form of information provision have been described by Hadley.[31] The role of the provision of written information to improve compliance has been reviewed in detail by Ley.[32] The use of patient information leaflets, in conjunction with PMRs, is discussed in Chapter 5.

Channel Business Systems produced a system called *Charm*. This system had a unique feature to help the pharmacist in responding to symptoms. It had distinct areas of patient counselling with comprehensive diagnostic and interaction features.

Other systems were noted by Strickland-Hodge,[29] including a selection of those available from pharmacy wholesalers. These included Macarthys *Choice*, Mawdsley-Brooks and Graham Tatford.

1.3 Patients' Views on Medication Records

A number of papers have been published to support the view that community pharmacists' use of PMRs appear to have been well received by patients.[33,34] It is less clear whether the use of PMRs increases patient loyalty to a particular pharmacy. Davis and Rubinstein reported that they could not conclude whether or not PMRs increased patient loyalty, or increased patient-pharmacist interaction, although patients accepted PMR use.[33] Di Ponio *et al* disagreed with Davis and Rubinstein's conclusion on patient loyalty.[35] More recently, in a larger survey than used in Davis and Rubinstein's previous work, Britten *et al* concluded that a large majority of customers in four community pharmacies in London were in favour of computerised record keeping.[34] Patients endorsed specified advantages of the use of PMRs, including prescription checking and monitoring for drug interactions. Britten *et al* also found that in the pharmacies concerned, there were large numbers of patients almost always taking their prescriptions to those pharmacies, and that it would be possible to maintain complete medication records.[34]

1.4 Possible Methods of Data Transfer Within Primary Healthcare

Traditionally, information has passed between health care professionals by paper-based means, eg. prescription forms and consultants' letters to GPs, or by the spoken word, eg. telephone conversations. Two other possible methods of information flow within the NHS are described below: the use of "smart cards" and networked computing.

1.4.1 Smart Cards

The computer systems described in Section 1.2.4 store patients' records on the PC's hard disk. An alternative approach to storing records in a pharmacy or general medical practice computer system, is to give each patient a device, referred to as a "smart card", containing all their personal medical information. Credit-card sized smart cards were derived from cards developed for banking systems in the 1970s.[36] The first smart cards were produced in France by the Bull Company. Bull produced a card that contained a memory chip and microprocessor.[37] The first generation of cards contained a programmable read-only memory (PROM) chip. These cards could only be programmed once and data subsequently burnt on to the card could not be overwritten. An alternative method of production is to use electronically erasable read-only memory (EEPROM) cards. Cost and limited memory size have hindered the development of EEPROM cards. The GEC Company has developed an intelligent contactless (ic) card. This type of card has advantages in that it lacks surface contacts, unlike the other types of cards described above. Power and data transfer are achieved by an inductive radio frequency.

Using the concept of the smart card, patient data becomes the responsibility of the patient himself, who takes the card between health care providers. The providers of health care have security access to different parts of the record. For example, a pharmacist might be able to access data about medication history and drug allergies,

whereas general practitioners would be able to access the whole of a patient's medical history.

The first trial of smart cards in the NHS was in Rhydyfelin, South Wales, in 1986-1987.[38] This trial used a Sinclair QL microcomputer and PROM cards produced by the MIPS Company of Japan. It showed that the card system worked, although with a card failure rate of 4.6%. The trial was further hindered by patients not carrying their card to the surgery or pharmacy. This trial was continued for a further two years , and in a second report on the trial the authors concluded that the interchange of data between pharmacies and GP surgeries was feasible on patient-retained computer-accessible devices.[39]

A more comprehensive trial of smart cards has been completed in Exmouth, Devon.[40] This second UK trial involved the use of 8500 patient *Care* cards. In the Exmouth trial, the concept of a portable patient record was expanded to include clinical data. Two general medical practices, eight community pharmacies, one dental practice and two hospitals participated in the Exmouth trial. Several problems became apparent including access times of 50-60 seconds for large records, sparse records being placed on the cards at surgeries and problems of poor patient education. In the published report on the project findings, no conclusive advantages in patient care could be demonstrated by the use of the *Care* card.[41] A third UK trial of smart cards is currently being undertaken in Scotland.[41]

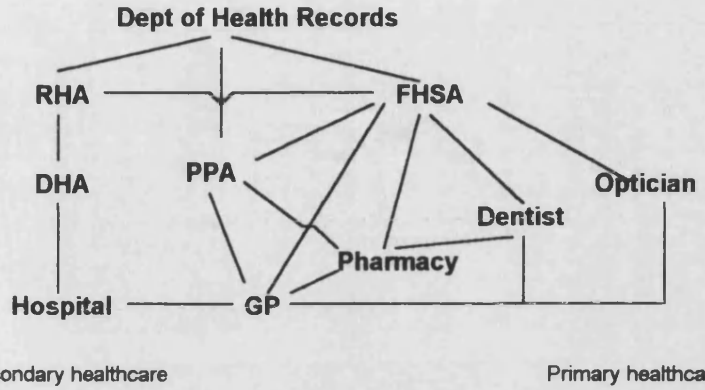
A new type of computer mass storage is the PCMCIA card (Personal Computer Memory Card International Association). This could have potential uses in medical applications, including the transfer of patient-held data between providers of health care.[43]

1.4.2 NHS Computer Networking

Stevens highlighted the possible advantages of the smart card, including the use of cards to replace paper prescriptions.[37] However, smart cards have not yet proved to be effective. Evidence presented in the literature leads one to the conclusion that smart cards do not have a positive future in the NHS due to their inherent high cost, unproved technology and patient non-compliance. In addition valuable research data could be lost if smart cards were to become the only means of storing patient records. To maintain a research database of patient records, patient data would need to be stored on a computer system elsewhere in the health care system; therefore it could be argued that there is little need for smart cards, due to duplicity.

Electronic data interchange is an alternative way forward for the health service. Essentially, within this approach, all providers and managers of health care delivery would use computers that are linked to each other, either directly on a network or using a modem over telephone lines. For example, a general practice surgery could send prescriptions to a pharmacy by electronic mail. The pharmacy could, in return, update patient records to and from the surgery computer. The Prescription Pricing Authority (PPA) could pay pharmacists for medicines as soon as they are dispensed, and then feed data about dispensed medicines back to the surgery. Dentists, optometrists and hospitals could all be linked into this network. While programming and co-ordinating the network would be a formidable task, most links in the above network are already computerised. A possible model for electronic data interchange is shown in Figure 1.1.

Figure 1.1: Possible model for electronic data interchange within the NHS.



Plans for a project to make community pharmacists' dispensary computers compatible with those used in doctors' surgeries were announced by the Department of Health in November 1991.[44] While this project was never implemented, a project to "benchmark" test a number of community pharmacy computer systems was announced by the RPSGB in January 1993. The purpose of this latter project was to be able to make meaningful comparisons between those systems that were available for use by community pharmacists.

1.5 Clinical Coding

Clinical coding can be considered as a means by which details of patients and their clinical conditions can be encoded, thus facilitating automated processing of the coded patient data. At the time of writing, there is no standard form of coding pharmacy-held patient records. A number of clinical coding systems are used across the world.[45] These include the World Health Organisation's International Classification of Diseases (ICD-9) and the International Classification of Primary Care (ICPC), developed by the World Organisation of National Colleges, Academies, and Academic Associations of General Practitioners / Family Physicians (WONCA).[46]

In the UK, however, the medical profession has started to move towards a standardised system.[47] The Secretary of State for Health has acquired the Read clinical classification, for the purpose of its implementation throughout the National Health Service. This is the most comprehensive medical coding system in the world, containing over 250 000 codes. The classification provides codes for the following: diseases; history and symptoms; examination findings and signs; preventative, operative, therapeutic, and administrative procedures; drugs and appliances; and occupations and social information. The Read coding system was described by its originator, Dr James Read, as a system for coding the whole of medicine.[48] Read summarised the clinical uses of his system as including: structured medical records and notes; call and recall systems for preventive medical care; expert systems and clinical protocols for diagnosis, treatment and follow-up care of patients; self audit, peer audit and policy planning; administration, including accountancy and financial control. He described the statistical applications of his coding system as: clinical trials and research; health service management and planning; health and sickness surveys and epidemiology; pharmaceutical and actuarial market research; and international comparisons.

The use of the Read clinical classification (Read codes) will help in clinical care by facilitating the recording and retrieval of information as part of a medical record, enabling statistical analysis of data for planning and research purposes, and beciming a key element in the electronic transfer of information from one computer to another.

The benefits of the Read clinical classification for the medical profession and pharmacists have been documented.[49] Pringle recognised that having access to standardised patient information would benefit patients, those in health care provision, and to those managing the internal market of the NHS. It is therefore important that those who provide computer systems for pharmacists should be fully aware of

developments in medical computing to ensure that the pharmacy profession is not left behind as these developments are implemented in the NHS.

1.6 Aims and Objectives of Project

The aims of this project are to assess the impact of the use of PMRs on the practice of community pharmacy in England and Wales; to determine the types and uses of PMR systems in use; and to evaluate the clinical benefits to patients of PMR use.

The first objectives of the project are to determine the extent to which PMRs are used; to determine the types of system in use and the uses to which PMR systems are put; and to evaluate the clinical benefits to patients of pharmacists' use of PMR systems. A survey of 744 community pharmacies has been undertaken to achieve these objectives. This survey is presented in Chapter 2 of the thesis.

Patient information leaflets are provided for patients by some PMR systems. The objectives of the survey described in Chapter 5 are to determine the use of patient information leaflets in community pharmacy, and to examine the effect that the use of patient information leaflets has on compliance.

PMR systems are also used in the United States of America (USA); the objective of the study outlined in Chapter 6 is to compare and contrast PMR systems used in the UK with those used in the USA.

One of the principle objectives of the project is to demonstrate that the use of PMRs by a community pharmacist, through his making a clinical intervention, can reduce the risk to a patient of adverse effect from a drug interaction, the supply of a contraindicated medication, or an inappropriate dose. The use of PMR systems in safeguarding patients is described in Chapter 7.

Patients views on pharmacists' use of PMR have been solicited, and published.[34] However, prescribers' opinions have not been published in the literature. An objective of this research project is to determine general practitioners' (GPs) views on the retention of patients' medication records in primary health care, with particular reference to community pharmacy-held PMRs. A survey of all GPs in contract with Avon and Devon FHSAs is presented in Chapter 9.

2 The Extent to Which PMRs are Used in Community Pharmacy

2.1 Data Gathering and Survey Methods

Research in the traditional pharmaceutical sciences has used laboratory experiments that directly measure certain variables to produce data which can be measured on an interval or ratio scale of measurement.[50] This approach is inappropriate for many studies in pharmacy practice which require the application of survey methods developed by social scientists.

Social scientists use a number of basic techniques to gather data to prove or disprove a hypothesis. One method is to examine data retrospectively using documented literature sources; an example of this method is a longitudinal time study of population census data. Another method involves measuring and assessing observations in a normal or controlled environment; a research worker examining the sex of patients using a pharmacy could use this method by observing the number of male and female patients walking through the front door of the pharmacy.

Social scientists often refer to the use of data gathering in surveys by interview or questionnaire as the "experimental method."[51] Research may be carried out to measure a variable and/or derive some statistical inferences from the variable(s). The latter requiring the researcher to state the hypotheses he wishes to test, and develop a plan of how to gather the data needed to prove or disprove the hypotheses.

Factors which must be considered in social science research include the costs in terms of time and finance, the problems of sampling, non-respondents and the limits of data measurement. Most research projects are undertaken within financial limits. Experimental methods must be used which can be accommodated within such limits. For example, if a researcher needs to interview 10 000 customers to determine attitude to a product, but funds are only available to interview 5000 customers, he must accept the use of a smaller sample or use a less expensive method of gathering data.

Generally it is not possible to gather data from all the individuals making up a total population. Researchers use the method of sampling to obtain a smaller data set which is representative of the total population. Two sampling methods are commonly used. These are random sampling and stratified random sampling. Random sampling draws individual units from the total population at random, and assumes that all units in the total population have an equal probability of being drawn. Stratified random sampling is a refinement of random sampling which enables the use of smaller sample sizes.[51] This method involves random sampling from defined sub-populations taken from the total population. Determining the minimum sample size is a complex process, but sample size tables can be produced to give approximate requirements.[52]

A major problem in survey research is non-response. If 40% of a sample respond to a survey and 60% do not, then one must question whether the results from the 40% are representative of the whole sample. There are no absolute guidelines to resolve this problem, but increasing sample size and response rate increase the validity of results. Such bias must be acknowledged, and, where possible, accounted for statistically.

In order to quantify and assess the benefits of PMRs, held in pharmacies, to the profession, patients and to the NHS, the usage of PMRs needed to be quantified. Therefore, it was decided that the first stage of the research into the use of PMRs would be to conduct a detailed examination of how PMRs are currently used in England and Wales.

The survey method chosen to obtain the largest possible amount of data at the lowest possible cost was postal questionnaire.[51,52] Other possible research methods were telephone survey and on-site data collection. Telephone methods are time-consuming and expensive and can produce high refusal rates. Although face-to-face interviews can generate high quality qualitative data, it was considered that visiting pharmacies to

conduct such interviews on a national basis was not practicable due to cost and time limitations.

The purpose of the questionnaire was: to determine current attitudes towards PMRs and patient information leaflets; to quantify the number of pharmacies using PMRs; to identify the types and suppliers of PMRs used; and to elucidate which patient and product details were being recorded. Factors which may affect PMR use were recorded: these included the ownership, location and client base of a pharmacy; the age, sex, and status of the pharmacist in charge of the pharmacy; the numbers of prescriptions dispensed; the numbers of patients held in the PMR system; and the location of PMR computer terminals.

Statistical methods used in the research project are summarised in Appendix 1.

2.2 Method

2.2.1 Equipment and Materials Used

Questionnaire forms and other project documents were produced using Microsoft Word for Windows V1.1 on a Viglen Genie 3SX IBM-compatible computer and a Hewlett-Packard Deskjet 500 printer. The program SPSS/PC+ V3.1 (formerly known as *Statistical Package for Social Sciences*)[53] was used to record results from returned questionnaires and for statistical analysis of the data. A Freepost licence agreement was signed with the Post Office for the purpose of processing of returned questionnaires.

2.2.2 Design of Questionnaire

The survey questionnaire (Appendix 2, page 310) was developed by listing factors that could affect a pharmacist's use of PMRs. These were grouped into details about the pharmacy; the pharmacist working in that pharmacy; his attitude towards PMRs; use of PMRs; details stored in PMRs about patients; details stored in PMRs about products; and attitudes towards patient information leaflets.

The questionnaire was divided into eight sections as follows:

Section A: The pharmacy

Section B: The pharmacist

Section C: Attitudes towards patient medication records

Section D: Use of PMR systems

Section E: Details of PMRs relating to patients

Section F: Details of PMRs relating to products

Section G: Patient information leaflets

Section H: Further research

The first set of questions (Section A) included details about whether the pharmacy was independent, a small multiple (2-10 branches) or a large multiple (>10 branches). Pharmacy location was characterised by asking the respondent to describe the site of their pharmacy and the client base. The site covered options for city centre, suburban, village/small town centre, health centre, hospital and in-store pharmacies. There are several methods for classifying social class or socio-economic group.[54] From the author's management experience in community pharmacy, it was felt that pharmacists would be best able to classify their patients by the Market Research socio-economic classification.[55] An approximation of the level of activity was sought by requesting the number of prescriptions dispensed each week.

The next set of questions (Section B) requested details about the pharmacist in charge of the pharmacy. Information was sought with regard to the pharmacist's status as owner/manager, sex, year of registration, and the number of pharmacists practising in the pharmacy at any one time. It was thought that some of these variables about pharmacists and the pharmacy in which they practised could affect attitudes to and use of PMR systems.

Leading into the use of PMR systems (Section C), questions were asked about the respondent's attitudes to the effects of PMRs on the community pharmacist's clinical role and professional status, and possible benefits of time and finance. Respondents were asked whether they used a PMR system (Section D), and if so, whether manual, computerised or smart card. If not, they were asked about their possible intention to set up PMRs. The date of installing the PMR system being used was requested along with the system supplier, listing those systems reviewed by Strickland-Hodge.[29] The number of patient records stored in the system was requested in order to analyse whether this increases with time, or is affected by other factors.

Boots The Chemists and other multiple pharmacy groups have undertaken pilot studies in which computer equipment has been placed at the patient-pharmacist interface. Questions were asked as to where the PMR computer system was located and who normally entered patient details. This was to facilitate the examination of whether having the pharmacist and computer equipment away from the traditional dispensing area had an effect on the nature of data recorded.

The facility to record details about patients varies between PMR systems. Users of manual systems can record any information they wish, although such data is not "intelligent" in that it cannot interact automatically with data about prescribed medicines. Questions were then devised such that respondents were asked about the recording of a patient's name and title, address, telephone number, official reference numbers, and previous medication history (Section E).

A question was asked to determine whether pharmacists recorded information about the patient's race or ethnic origin, since the metabolism of some drugs is race-dependent.[56,57] It was not anticipated that many pharmacists would be recording this information.

It was anticipated that most pharmacists maintaining PMRs would keep records about the patient's general practitioner, and possibly dentist. Questions were asked about the recording of this information and also family planning clinics, hospital outpatient departments and alternative practitioners.

Many patients experience allergies or sensitivities to drugs or pharmaceutical excipients. Respondents were requested to state whether they recorded adverse reactions to colourings, preservatives and flavourings, salicylates, penicillin and non-steroidal anti- inflammatory drugs (NSAIDs). Several other drugs and allergens may provoke an adverse reaction, therefore respondents were also given an opportunity to

list any other recorded allergens. Other information requested in this section of the questionnaire covered prescription charge exemption and a patient's inability to use child resistant closures .

Some suppliers of PMR systems provide pharmacists with an on-screen prompt of patient conditions which may be recorded. Park Systems' PMR program provided a list of 26 conditions which may be incorporated into the patient record. This was the most comprehensive list in the PMR systems available at the time of developing the questionnaire (Autumn 1990) and formed the basis for a list of conditions in the questionnaire. The list was edited and other conditions such as pregnancy and breast-feeding were included in a revised list of 24 conditions about which respondents were asked to indicate whether or not they were referenced, as appropriate in patients' records.

Patients may cease to use a community pharmacy's service through death or relocation. Questions were therefore included to determine how pharmacists managed non-current records. Of particular interest was whether pharmacies passed information to patients or to another pharmacy in the event of a patient relocating.

The Data Protection Act 1984 requires confidentiality of information held on computer files and attributes to individuals the right to see their personal records.[58] Questions were placed in the questionnaire to enquire whether patients are reminded about their rights to access their records, and whether patients acted upon these rights.

The Channel pharmacy computer system (Channel Business Systems Ltd.) offers pharmacists the option of recording patient lifestyle details in the PMR. Respondents were asked to state whether occupation, smoking habits, alcohol consumption and height and weight details were recorded in the PMR. This was of interest to the study as smoking and patient weight may affect the pharmacokinetic profile of some

drugs.[56] Alcohol can potentiate the effects of a number of drugs including phenothiazines and barbiturates.[59]

Some pharmacies offer diagnostic testing as part of the community pharmacist's "extended role." These tests include blood pressure, serum cholesterol level and pregnancy testing. Respondents were thus asked to indicate if the results of such services were incorporated into the PMR. It was not anticipated that many pharmacists would include diagnostic test results. However, the author believes that the handling of diagnostic data could be a future development in PMR use. For example, a positive pregnancy test result for a female patient could automatically interact with the computer drug file to highlight a list of medicines that are contraindicated in pregnancy.

A series of questions was devised to determine how much detail was recorded about the products that were dispensed in pharmacies (Section F). It was anticipated that the vast majority of pharmacists would include full details about the name, form, quantity, strength and dose of dispensed medicines. However, it was felt that fewer pharmacists would include details about the source of dispensed medicines, including manufacturers, wholesalers, product licence numbers and batch numbers. Therefore, respondents were asked to indicate whether such details were recorded. Similar questions were applied to the recording of details about surgical dressings and appliances.

Non-prescription medicines may be contraindicated in certain disease states, for example hyoscine in closed-angle glaucoma, or may interact with prescribed medicines, for example pseudoephedrine with monoamine-oxidase inhibitors. Respondents therefore were asked to give an indication of how often they recorded details about non-prescription medicines.

General practitioners are currently able to prescribe drugs in whatever quantities they please. For example, many will prescribe in multiples of 28 or 30 for patients on repeat medication. Others will prescribe in quantities of 100 or some other number. The availability of calendar and original packs to the pharmacist may also influence the amount of medication dispensed to patients, since pharmacists will normally dispense the quantity closest to the nearest full calendar pack or sub-pack.[60] It is possible that patients could consistently receive more of one medicine than of another, giving potential for an excessive supply of some drugs. Pharmacists dispensing regular repeat medication for patients are in a position to monitor for such extravagant prescribing; respondents were therefore asked if they ever acted to prevent such excess medication from being dispensed. A research project has being undertaken to investigate fully this aspect of the community pharmacist's role in reducing unnecessary drug expenditure.[61]

Computerised PMR systems record drugs dispensed and the relevant directions to the patient as part of the labelling process. Many prescriptions are presented either with no directions, or "as directed" or "as before". In such circumstances pharmacists have the option of labelling medicines with directions previously recorded. Respondents were asked how they reacted to such prescriptions. It was anticipated that there could be significant variation between PMR users and non-PMR users.

Finally, a series of questions was included to assess pharmacists' attitudes to the use of computer-generated patient information leaflets.

The questionnaire forms were designed with multiple choice responses to all questions. This enabled all responses to be coded prior to analysis.[62] A codebook was produced enabling coders not familiar with the survey to code responses from returned questionnaires. Each response was coded with a possible number within the range 1-9. The coded responses were then entered into the SPSS/PC+ statistics program.

Some questions included a space for pharmacists to comment upon their answers, either in order to clarify their responses, or in circumstances where none of the provided multiple choice answers applied. A page was provided at the end of the questionnaire for comments about the survey and use of PMR systems. Each questionnaire form was coded with an identity number enabling a follow up questionnaire to be sent if no reply was received after a given period.

All questionnaires were addressed to the pharmacist in charge of each pharmacy. Each questionnaire was accompanied by a covering letter (Appendix 2, page 310) explaining the purpose of the study, and assuring pharmacists of the confidentiality of data collected.

2.2.3 Bath Pilot Study

Questionnaires were posted to 27 pharmacies in the Bath area at the end of December 1990. Responses were obtained from 17 pharmacists (63.0% response). This group consisted mainly of pharmacies owned by individual proprietors that were not therefore representative of the general population. However the returned forms were used to refine the questionnaire before being used nationally.

Questions in the pilot questionnaire about quantity and price of surgical appliances were considered superfluous and were deleted. The question about the recording of the family practitioner number of the patient's GP was replaced by asking about the recording of the patient's computer reference number used by doctors' surgeries. This was considered to be of more use with regard to cross-referencing pharmacy records with those held by GPs. The series of questions about the recording of patient conditions was followed by a space for the coder to sum the number of conditions recorded; this produced a number measured on the interval scale, enabling the use of more powerful parametric statistical procedures on subsequent results.

2.2.4 The National Survey

Determining the sample size for random sampling is a complex process, requiring knowledge of the population being measured and anticipating response rates.[51] Since several parameters relating to the use of PMRs were being measured and since resources were limited within the research budget, a sample size of 1000 pharmacies was considered adequate. This represented approximately 1 in 11 pharmacies in the United Kingdom, and as such was considered sufficiently large to see evidence of innovative practice where a low response was anticipated, for example in the recording of diagnostic test results.

The assumption was made that regional variability in the use of PMRs would not be considerable. The Royal Pharmaceutical Society of Great Britain was requested to produce a random sample of 1000 pharmacies from their computer records. A list was produced comprising 928 pharmacies in England and 72 in Wales.

The revised questionnaire was sent to these 1000 pharmacies in March 1991. At the same time, the questionnaire was sent to 124 pharmacies in England and Wales using the Hadley Hutt *PILLS* system, and which had not been included in the Bath pilot study or the random sample. Follow up questionnaires were sent to those pharmacies that had not replied to the initial questionnaire after six weeks.

2.3 Results

A total of 538 questionnaires (53.8%) was returned six weeks after issue. A further 206 questionnaires were returned after posting a second questionnaire and reminder to the non-respondents. This represented a total response of 74.4%. Questionnaires were received from 83 *PILLS*-users (66.9% response).

2.3.1 Pharmacy and Pharmacist Data

Frequency data from Section A of the questionnaire are shown in Tables 2.1-2.5. Results are shown side by side for returned questionnaires from the national survey and the *PILLS*-user sample. These figures represent details about the pharmacies in the survey.

Table 2.1: Regional location of pharmacies in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
Wales	61 (8.2%)	5 (6.0%)
London and Home Counties	97 13.1%)	20 (24.1%)
South East	121 (16.3%)	4 (4.8%)
South West	58 (7.8%)	10 (12.0%)
North East & Yorkshire	118 (15.9%)	6 (7.2%)
Midlands	146 (19.7%)	27 (32.5%)
Northwest	116 (15.7%)	11 (13.3%)
East Anglia	24 (3.2%)	0 (0.0%)
	741 (100%)	83 (100%)

Table 2.2: Ownership of pharmacies in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
Independent	365 (49.5%)	57 (68.7%)
Small multiple (2-10 branches)	155 (21.0%)	22 (26.5%)
Large multiple (>10 branches)	217 (29.4%)	4 (4.8%)
	737 (100%)	83 (100%)

Table 2.3: Location of pharmacies in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
City centre	56 (7.6%)	5 (6.0%)
Suburban	329 (44.8%)	45 (54.2%)
Village/small town	296 (40.3%)	27 (32.5%)
Health centre	22 (3.0%)	4 (4.8%)
In-store	17 (2.3%)	1 (1.2%)
Other pharmacies	15 (2.0%)	1 (1.2%)
	734 (100%)	83 (100%)

Table 2.4: Classification of patients' socio-economic group in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
AB	88 (12.0%)	16 (19.3%)
C1	27 (3.7%)	3 (3.6%)
C2	46 (6.3%)	5 (6.0%)
DE	294 (40.1%)	24 (28.9%)
Mixture, unable to classify	279 (38.0%)	35 (42.2%)
	734 (100%)	83 (100%)

Table 2.5: Average number of prescription items per week dispensed in pharmacies in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
0-199	18 (2.5%)	1 (1.2%)
200-399	89 (12.6%)	4 (4.9%)
400-599	187 (26.4%)	20 (24.7%)
600-799	148 (20.9%)	21 (25.9%)
800-999	83 (11.7%)	9 (11.1%)
1000-1199	61 (8.6%)	11 (13.6%)
1200-1399	45 (6.3%)	7 (8.6%)
1400+	78 (11.0%)	8 (9.9%)
	709 (100%)	81 (100%)

Table 2.6: Status of pharmacist in charge of pharmacy in national survey and *PILLS*-users survey (April 1991).

	National survey	*PILLS*-users
Proprietor	262 (35.7%)	44 (53.7%)
Partner	59 (8.0%)	7 (8.5%)
Superintendent	64 (8.7%)	7 (8.5%)
Manager	290 (39.5%)	22 (26.8%)
Locum	23 (3.1%)	0
Other	36 (4.9%)	2 (2.4%)
	734 (100%)	82 (100%)

Table 2.7: Sex of pharmacist in charge of pharmacy in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
Male	518 (72.1%)	64 (78.0%)
Female	200 (27.9%)	18 (22.0%)
	718 (100%)	82 (100%)

Table 2.8: Year of registration of pharmacist in charge of pharmacy in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
1986-1990	123 (16.9%)	9 (11.0%)
1981-1985	124 (17.1%)	19 (23.2%)
1976-1980	112 (15.4%)	11 (13.4%)
1971-1975	79 (10.9%)	8 (9.8%)
1966-1970	86 (11.8%)	12 (14.6%)
1961-1965	76 (10.5%)	15 (18.3%)
1956-1960	66 (9.1%)	6 (7.3%)
1955 or earlier	61 (8.4%)	2 (2.4%)
	727 (100%)	82 (100%)

Table 2.9: Number of full-time equivalent pharmacists working at any one time in national and *PILLS*-user survey pharmacies (April 1991).

	National survey	*PILLS*-users
1	608 (82.9%)	65 (79.3%)
1.5	66 (9.0%)	11 (13.4%)
2	42 (5.7%)	5 (6.1%)
2.5	7 (1.0%)	0
3	8 (1.1%)	1 (1.2%)
More than 3	2 (0.3%)	0
	733 (100%)	82 (100%)

Tables 2.6-2.9 show the frequency data from Section B of the questionnaire relating to the pharmacist(s) working in the pharmacy.

In Section C of the questionnaire, pharmacists were asked about their agreement with a series of five statements about PMRs. Their responses are given in Tables 2.10-2.11. Table 2.10 shows the data from the national survey and Table 2.11 the data from the *PILLS*-user survey.

Factors which may have influenced a pharmacist's agreement with the statements about PMRs were examined by cross-tabulating the results from the national survey in Table 2.10 with all the responses from Tables 2.1-2.9. The Kruskal-Wallis one-way analysis of variance[63,64] was applied to the cross-tabulated responses to determine the significance of these influences.

Recently-qualified pharmacists were more positive about the use of PMRs in their response to all the statements. The pharmacist's year of registration had a significant effect on responses to the following three statements:

> *The use of PMRs enables the community pharmacist to fulfil a more clinical role* (H=16.24, corrected for ties, df=28, $p<0.05$).

The use of PMRs wastes pharmacist time (H=16.27, corrected for ties, df=28, $p<0.05$).

On balance, PMRs give a financial benefit to the pharmacist (H=16.88, corrected for ties, df=28, $p<0.05$).

In each case younger pharmacists viewed the use of PMRs more positively than their less recently registered colleagues.

Table 2.10: Pharmacists' agreement with statements about PMRs.

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
The use of PMRs enables the community pharmacist to fulfil a more clinical role	26.7	55.7	14.0	2.2	1.4	100% (n=727)
The use of PMRs enhances the professional status of the pharmacist	27.1	52.7	15.9	3.3	1.0	100% (n=728)
The use of PMRs wastes pharmacist time	1.0	6.4	12.5	44.2	36.0	100% (n=720)
The use of PMRs saves ancillary staff time	7.5	34.3	34.7	20.6	2.9	100% (n=720)
On balance, PMRs give a financial benefit to the pharmacist	4.9	23.8	43.1	21.4	6.9	100% (n=720)

Pharmacists from large multiples were more in agreement with the statement that PMRs provided financial benefits than those from small multiples or independents (H=12.14, corrected for ties, df=8, $p<0.01$). No other significant influences were found.

Table 2.11: *PILLS*-users' agreement with statements about PMRs.

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
The use of PMRs enables the community pharmacist to fulfil a more clinical role	48.8	42.7	8.5	0.0	0.0	100% (n=82)
The use of PMRs enhances the professional status of the pharmacist	51.2	40.2	7.3	1.2	0.0	100% (n=82)
The use of PMRs wastes pharmacist time	0.0	0.0	7.3	28.0	64.6	100% (n=82)
The use of PMRs saves ancillary staff time	17.1	39.0	25.6	14.6	3.7	100% (n=82)
On balance, PMRs give a financial benefit to the pharmacist	12.2	34.1	34.1	14.6	4.9	100% (n=82)

2.3.2 Use of PMR Systems

Tables 2.12-2.16 show the frequency data from Section D of the questionnaire. This Section concerned the use of PMRs and the types of systems used.

Table 2.12: Use of PMR systems (April 1991)

Manual system	45 (6.1%)
Computer-held	407 (55.4%)
Smart card	1 (0.1%)
Planning to install system	99 (13.5%)
Will possibly install system	85 (11.6%)
No intention to install system	97 (13.3%)
	735 (100%)

From Table 2.12 it can be observed that 61.6% of the sample were using a PMR system at the time of the survey (April 1991). A further 13.5% were planning to install a PMR system and 11.6% stated that they may possibly install a PMR system. It can thus be postulated that 75-85% of community pharmacies would have been using PMRs subsequent to this survey.

Factors which may influence the use of PMRs were investigated by cross-tabulating the results in Table 2.12 with those from Tables 2.1-2.9. Regional variations in the use of PMRs existed, ranging from 50% of pharmacies in the South West and 51% in the South East maintaining a PMR system, to 74% in the North West and 75% in East Anglia.

Figure 2.1 shows that pharmacies dispensing less than 400 items per week were less likely to use a PMR system than those pharmacies dispensing a higher number of prescriptions. The use of PMR systems clearly was dependent upon dispensing volume (χ^2=62.2, df=35, $p<0.01$).

Figure 2.1: Average number of items dispensed per week related to percentage of pharmacies maintaining a PMR system (April 1991).

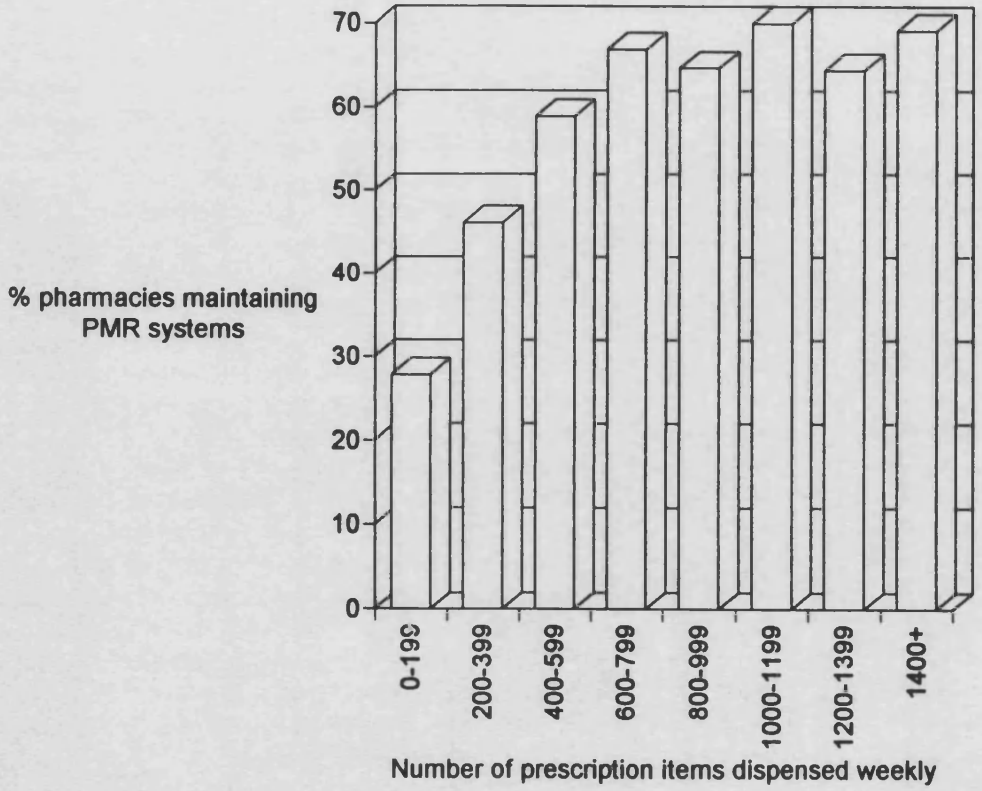
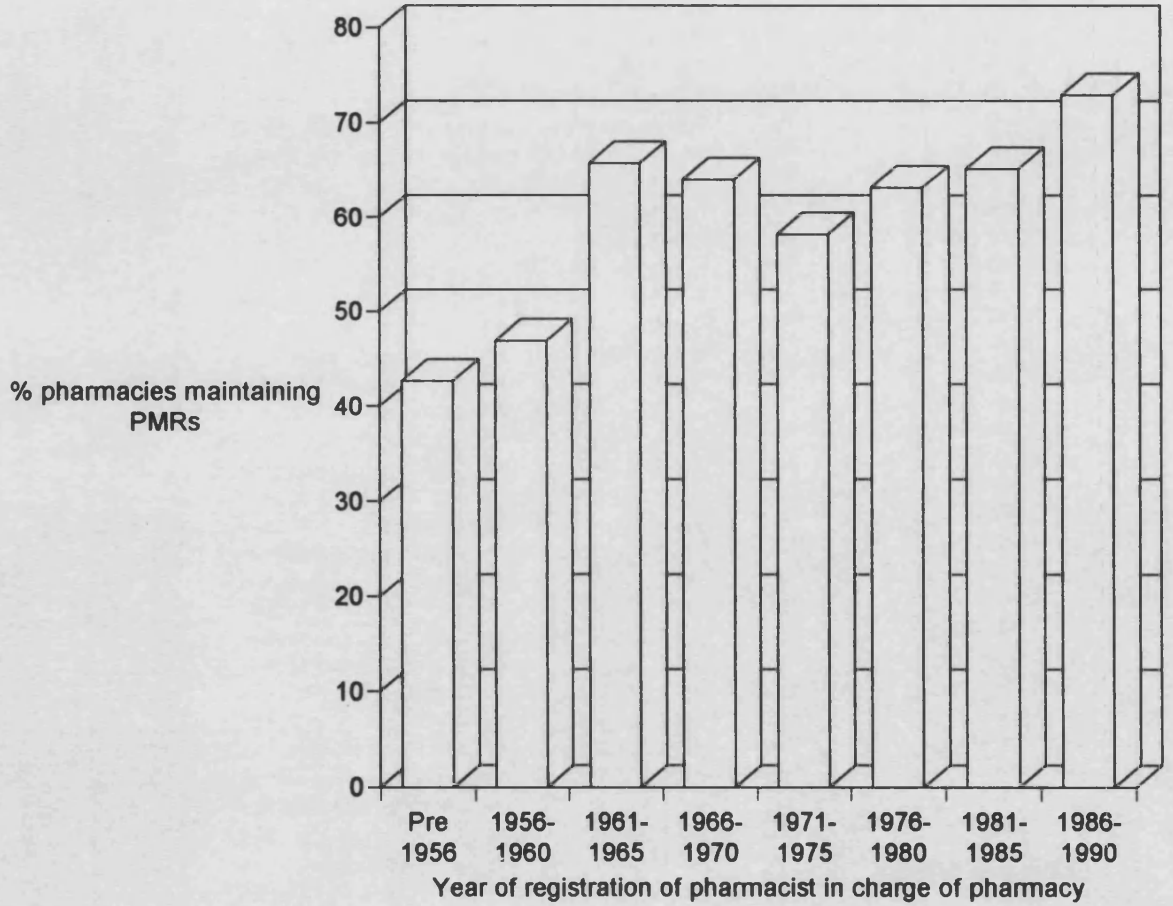


Figure 2.2: Relationship between the use of PMR systems (April 1991) and the year of registration of pharmacist in charge of pharmacy.



The status of the pharmacist in charge of the pharmacy affected the use of PMRs (χ^2=60.9, df=25, p<0.01). Of those pharmacies where a locum was the pharmacist in charge 26.1% (n=23) used a PMR system. This figure rose to 81.4% (n=59) where partnerships existed. No significant difference in the use of PMR systems was found between managers and proprietors.

Figure 2.2 shows that older pharmacists were less likely to be in charge of a pharmacy where PMRs are maintained (χ^2=65.0, df=35, p<0.01).

Table 2.13. Year of installation of PMR system in use during April 1991.

	National survey	*PILLS*-users
1991	22 (4.9%)	0
1990	224 (50.3%)	63 (75.9%)
1989	121 (27.2%)	15 (18.1%)
1988	50 (11.2%)	3 (3.6%)
1987	14 (3.1%)	2 (2.4%)
1986 or earlier	14 (3.1%)	0
	445 (100%)	83 (100%)

Note: The *PILLS* group contained no entries for 1991 because the list of *PILLS* pharmacies was provided by Hadley Hutt Computing Ltd during December 1990.

Figure 2.3 shows the market share, as of April 1991, for program suppliers of PMR systems.

Figure 2.3: Market shares held by suppliers of PMR systems in April 1991.

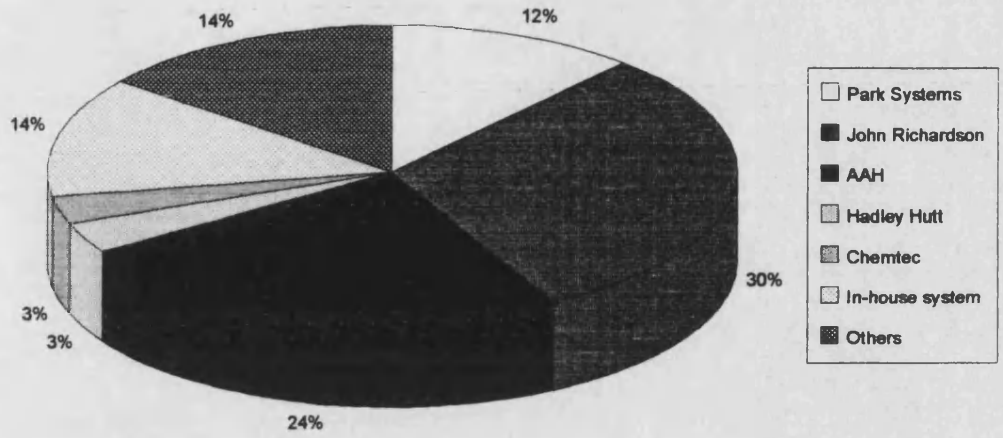


Table 2.14: Number of patient records held in manual and computer records (April 1991).

	National survey	*PILLS*-users
0-499	103 (23.3%)	0
500-999	72 (16.3%)	2 (2.4%)
1000-2499	103 (23.3%)	12 (14.6%)
2500-4999	89 (20.1%)	21 (25.6%)
5000 or more	70 (15.8%)	45 (54.9%)
Don't know	6 (1.4%)	2 (2.4%)
	443 (100%)	82 (100%)

Table 2.15: Location within the pharmacy of the PMR computer keyboard in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
Dispensary	383 (94.8%)	79 (95.2%)
Reception / counselling area	16 (4.0%)	2 (2.4%)
Medicines counter	3 (0.7%)	0
Elsewhere	2 (0.5%)	2 (2.4%)
	404 (100%)	83 (100%)

Table 2.16: Person normally initiating a patient record.

	National survey	*PILLS*-users
Pharmacist	256 (63.2%)	49 (59.0%)
Dispensing assistant	16 (4.0%)	6 (7.2%)
Other assistant	3 (0.7%)	1 (1.2%)
Combination of the above	104 (25.7%)	27 (32.5%)
	405 (100%)	83 (100%)

2.3.3 The Recording of Patient Information

In section E of the questionnaire, pharmacists were asked to state those details which were normally recorded about patients. Data from the national survey and, where appropriate the *PILLS*-user survey, are shown in Tables 2.17-2.32. The data was cross-tabulated with the data about the pharmacy and the pharmacist in charge, from Tables 2.1-2.9, and also with the computer system supplier. Significant findings are reported after the frequency data.

Table 2.17: Recording of patients' previous medication history by participants in the national survey and *PILLS*-user survey (April 1991).

	National survey	*PILLS*-users
Always	23 (5.2%)	4 (4.8%)
Usually	44 (9.9%)	7 (8.4%)
Sometimes	114 (25.7%)	18 (21.7%)
Never	262 (59.1%)	54 (65.1%)
	443 (100%)	83 (100%)

Table 2.18: Percentage of respondents recording a patient's personal details in national and *PILLS*-user surveys April 1991.

	National survey (448=100%)	*PILLS*-users (82=100%)
Surname	100.0	100.0
Address	98.7	100.0
First / given name	90.4	98.8
Title	76.1	11.0
Sex	74.3	65.9
Initials	62.6	42.7
Age / date of birth	43.9	68.3
Telephone number	31.0	18.5
NHS number	3.1	3.7
National Insurance number	1.1	1.2
Race / nationality	0.2	0.0
Hospital record number	0.0	1.2

Patient medication records were maintained for all patients by 30.4% of respondents (75.6% of *PILLS*-users). The only factor that influenced the maintenance of records for all patients was system supplier (χ^2=21.35, df=6, p<0.01). Figure 2.4 illustrates this effect.

Figure 2.4: The percentage of system users who recorded prescriptions for all patients (April 1991).

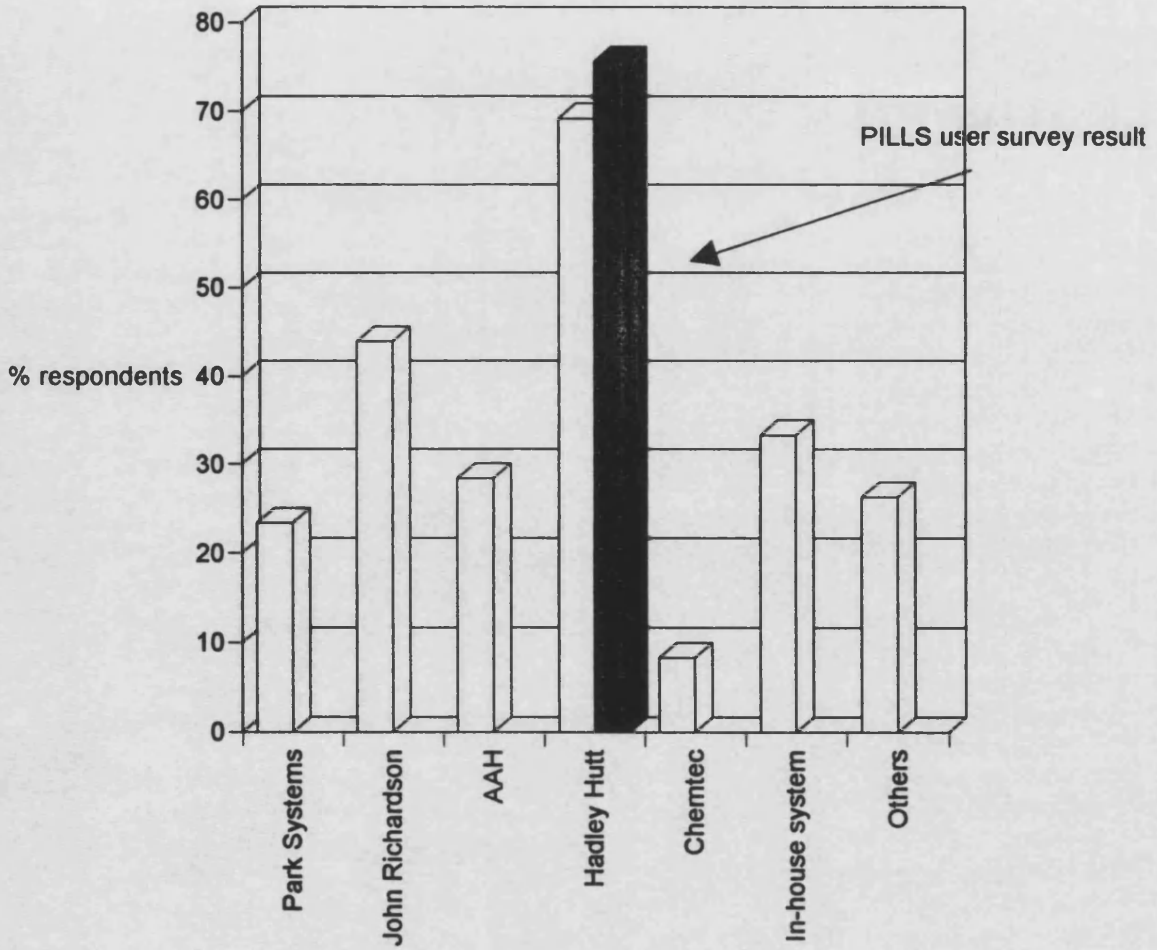


Table 2.19: Patient groups for whom records were kept if records were not maintained for all patients (national survey and *PILLS*-user survey, April 1991)

	National survey (314=100%)	*PILLS*-users (21=100%)
Local patients	35.8	81.0
Patients over 60	52.2	38.1
Patients with regular repeat prescriptions	77.4	42.9
Other groups	32.2	19.0

Table 2.20: Numbers of pharmacists indicating other groups of patients included in PMR where records were not maintained for all patients (national survey, April1991).

18	Diabetics
17	Ostomists
11	Asthmatics
9 each	Epileptics; Residential and nursing home patients; Drug addicts
6	Children
4	Women on oral contraceptives
3 each	Confused patients; Patients requiring hosiery; Coeliac patients
2 each	Patients requiring oxygen; Hypertensives; Polypharmacy patients; Patients who have repeat prescription errors; Patients on special formulations
1 each	Hypochondriacs; Catheterised patients; Patients on dialysis; Patients with unusual items; Pregnant women; Breast-feeding mothers; HRT users; Psychiatric patients; Transplant patients; Truss wearers; Those with heart defects; Those on expensive drugs; Mentally handicapped patients; Allergic patients; Home delivery patients; Where time could be saved in dispensing process; All those with computer-generated prescriptions; Those who work locally; Patients in home for mentally handicapped young adults

In the national sample all the pharmacists who recorded details about alternative practitioners served patients from the AB socio-economic group (Table 2.21). The alternative practitioners referred were two homoeopathic doctors, a private practitioner, chiropractor and a private consultant. In the *PILLS*-user group five out of those eight pharmacies noting alternative practitioners served the AB socio-economic group.

Table 2.21: Percentage of respondents recording details of a patient's prescriber (national and *PILLS*-user surveys, April 1991).

	National survey (447=100%)	*PILLS*-users (83=100%)
GP's name	96.4	96.4
GP's address	56.6	77.1
GP's computer patient reference number	11.6	12.0
Dentist's name	27.7	49.4
Dentist's address	12.3	37.3
Family planning clinic	1.3	7.2
Hospital outpatients department	4.3	20.5
Alternative practitioners	1.8	9.6

Table 2.22: Percentage of respondents recording patients' allergies, sensitivities and idiosyncratic reactions to drugs and allergens (national and *PILLS*-user surveys, April 1991).

	National survey (443=100%)	*PILLS*-users (83=100%)
Colourings, preservatives or flavourings	37.7	30.1
Salicylates	47.2	68.7
Penicillin	71.6	95.2
NSAIDs	45.4	67.5

Table 2.23: Number of cases of other allergens noted by pharmacists in national survey, April 1991.

12	Sulphonamides
6	Erythromycin
5	Antibiotics
3	House dust mite
2	Tetracyclines
1 each	Ointments, Lactulose, Cephalexin, Co-Dydramol, Egg, Pollen, Wasp stings, Nystatin, Eye ointments

The suitability of child-resistant closures for elderly and arthritic patients was noted by 73.9% of the respondents, and by 78.3% of *PILLS*-users.

Prescription charge exemption was recorded by 39.9% of the national sample, and by 27.7% of *PILLS*-users.

The recording of patient conditions was examined initially by determining the total number of conditions recorded by each pharmacy in the survey, and by noting the effect which parameters of the pharmacy and of the pharmacist in charge had an effect on this value. The effect of system supplier was also examined. Differences between population sub-groups were determined by performing a one-way analysis of variance test (ANOVA), which provided a 95% confidence interval for each mean value of conditions recorded. The exact population sub-groups contributing to the differences were detected by applying Fisher's LSD (Least Significant Differences) test.[64] Figures 2.5-2.10 illustrate where influences were found.

Analysing the results from Figure 2.5 showed that pharmacists working for large multiples recorded more conditions than independent pharmacists ($p<0.05$). However this effect was diminished when corrected for year of registration of the pharmacist in charge, since younger pharmacists were found to record more information; also a high proportion of young pharmacists was found to work for large multiples.

Figure 2.6 shows the effect of the socio-economic group of the pharmacy's patients on the mean number of conditions recorded in the PMR system. Analysis showed that pharmacists serving AB groups recorded fewer conditions than those serving the C2, DE groups or a mixed clientele ($p<0.05$).

Figure 2.5: The effect of pharmacy ownership on the mean number of patient conditions recorded in PMR systems.

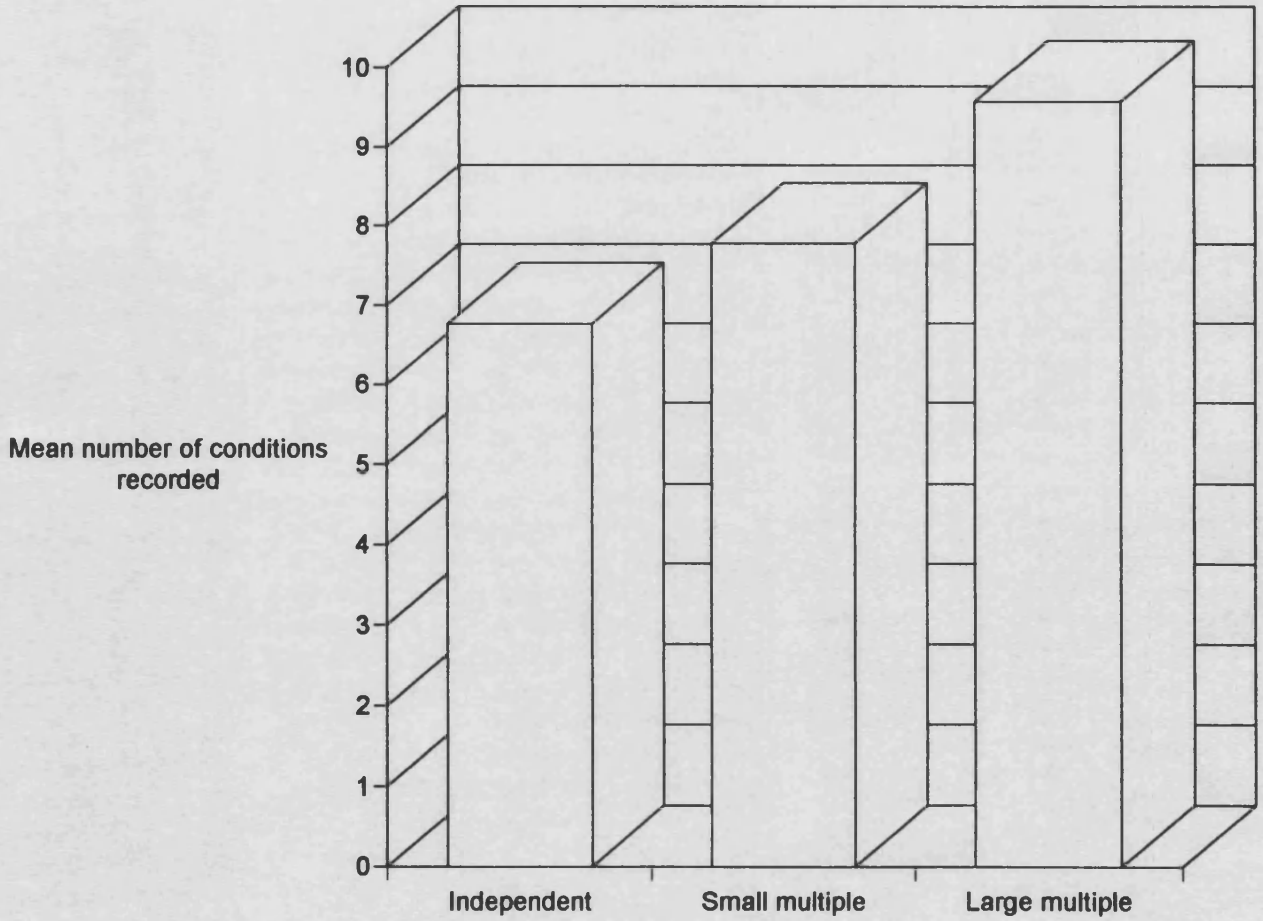


Figure 2.6: The effect of patient socio-economic group on the mean number of patient conditions recorded in PMR systems.

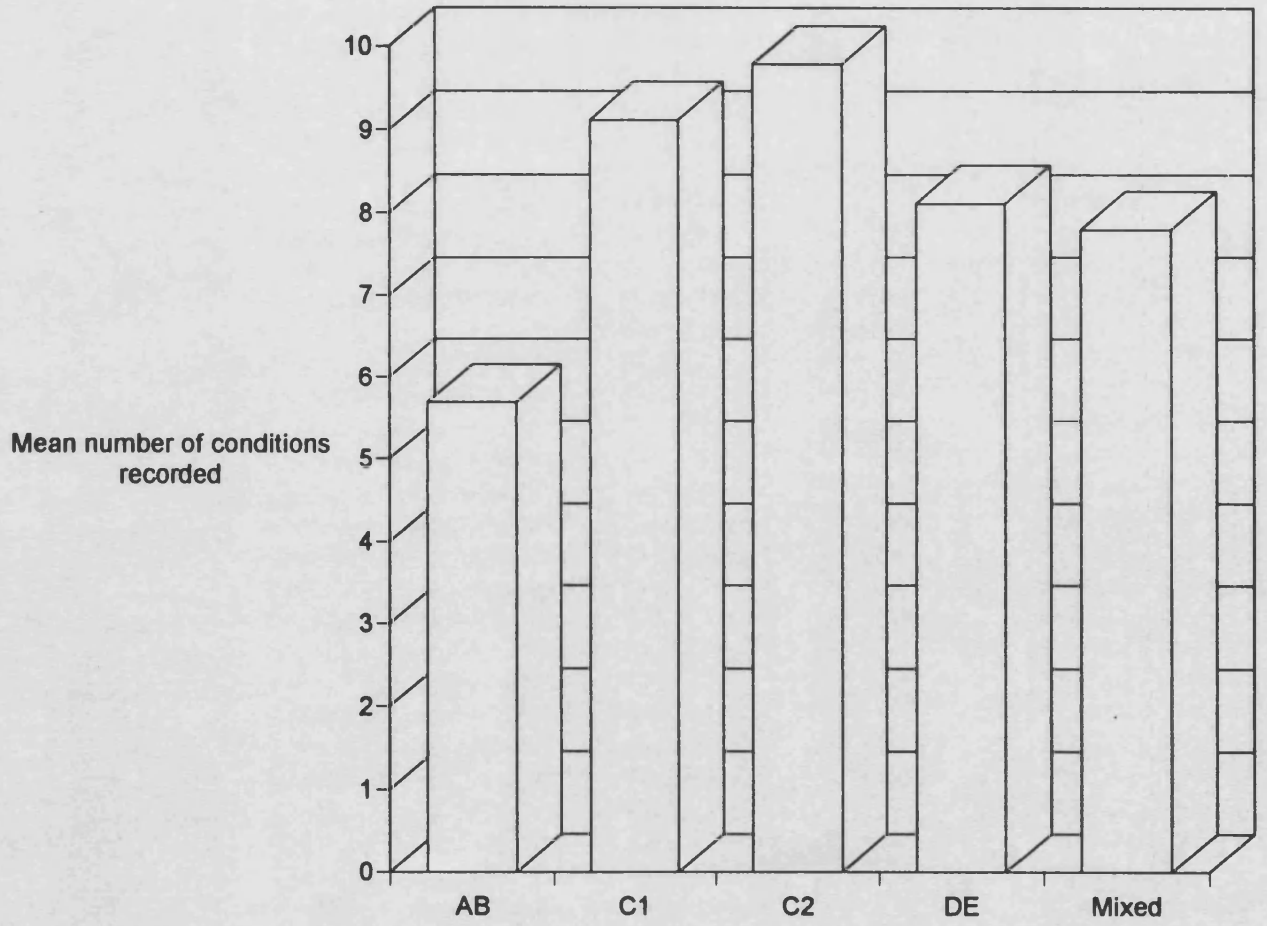


Figure 2.7: The effect of the year of registration of the pharmacist in charge on the mean number of patient conditions recorded in PMR systems

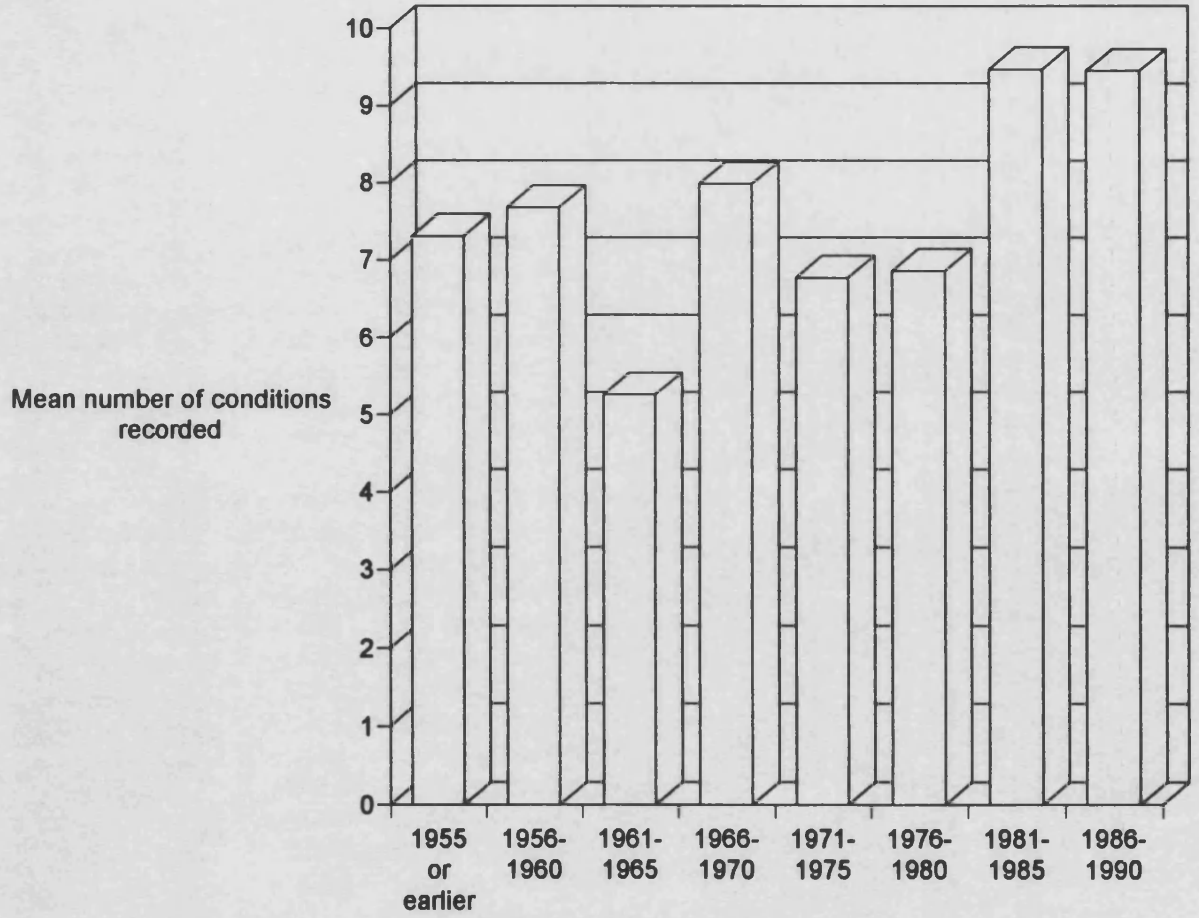


Figure 2.8: The effect of year of installation of PMR system on the mean number of patient conditions recorded in PMR systems.

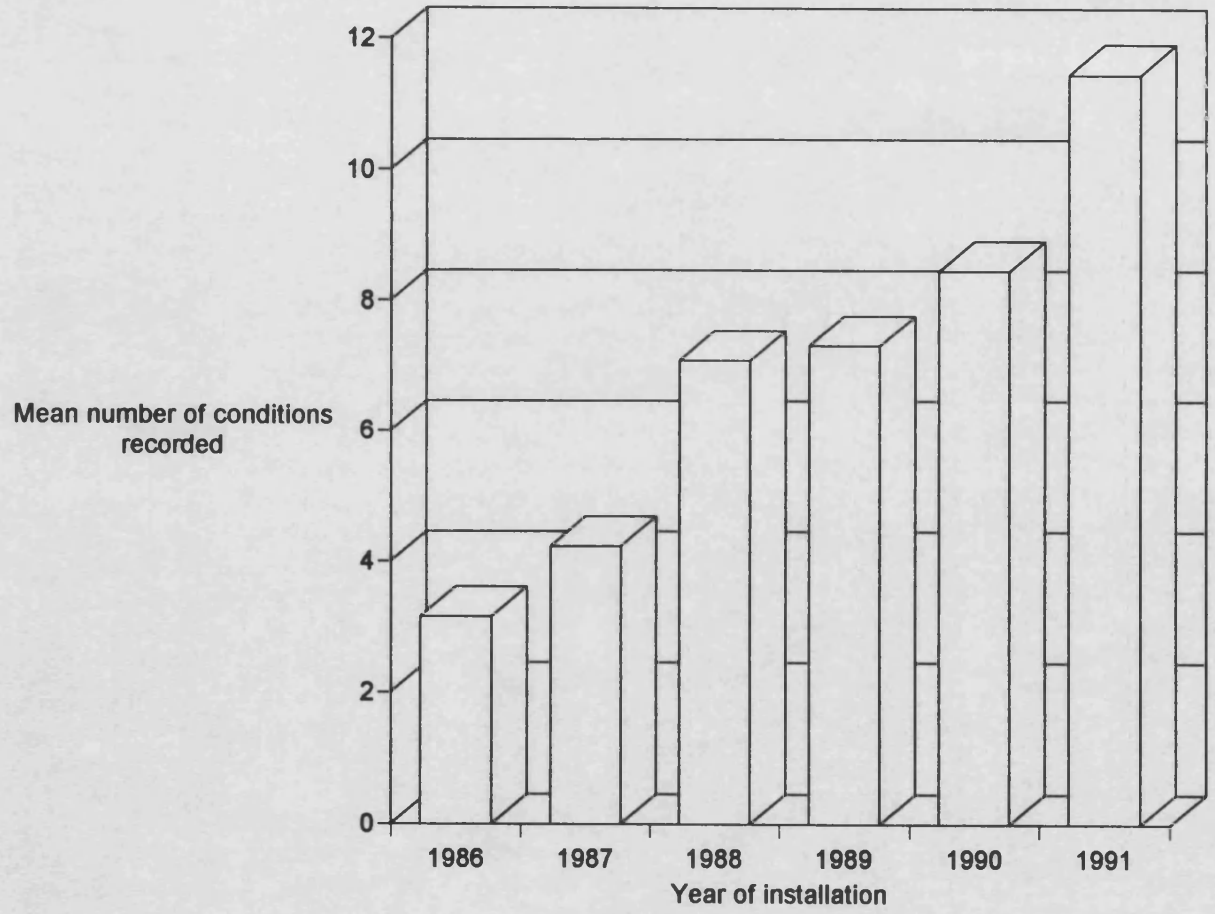


Figure 2.9: The effect of program supplier on the mean number of patient conditions recorded.

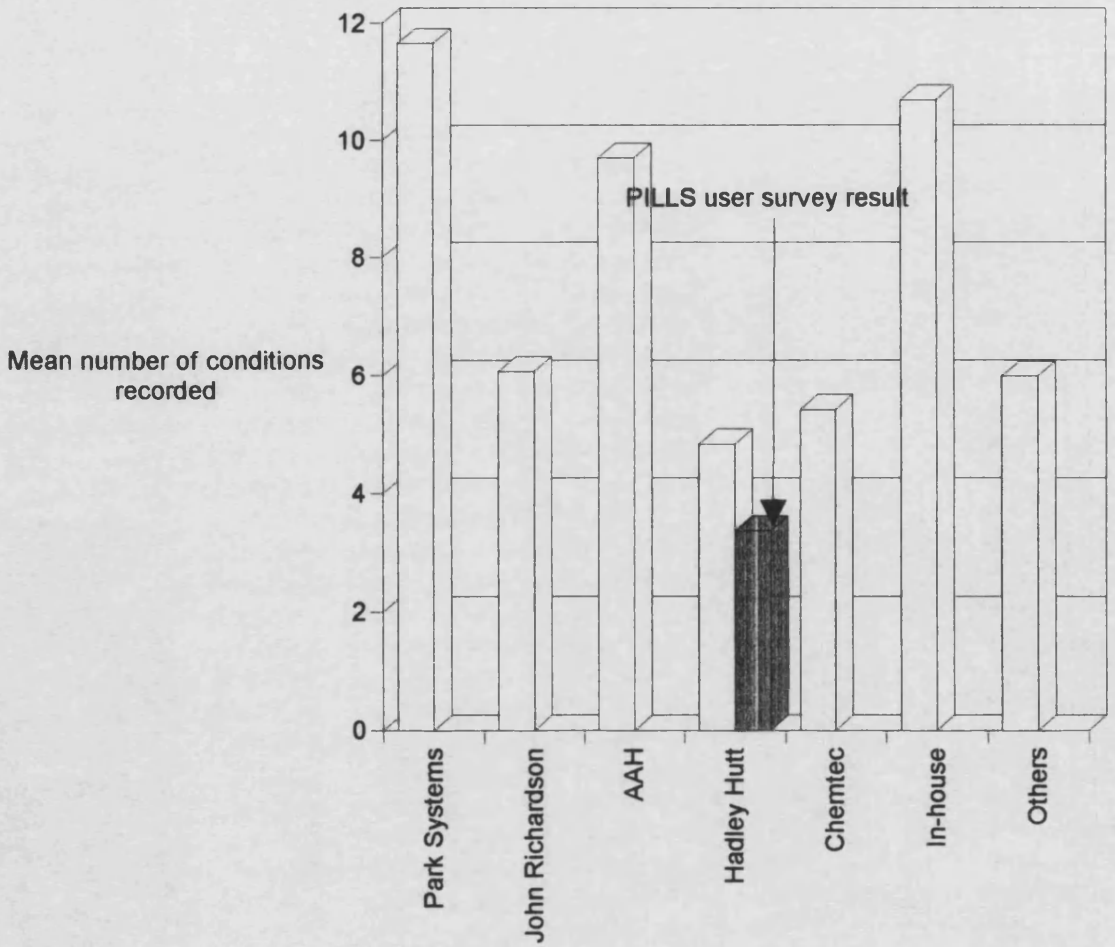


Figure 2.10: The effect of regional location on the mean number of patient conditions recorded.

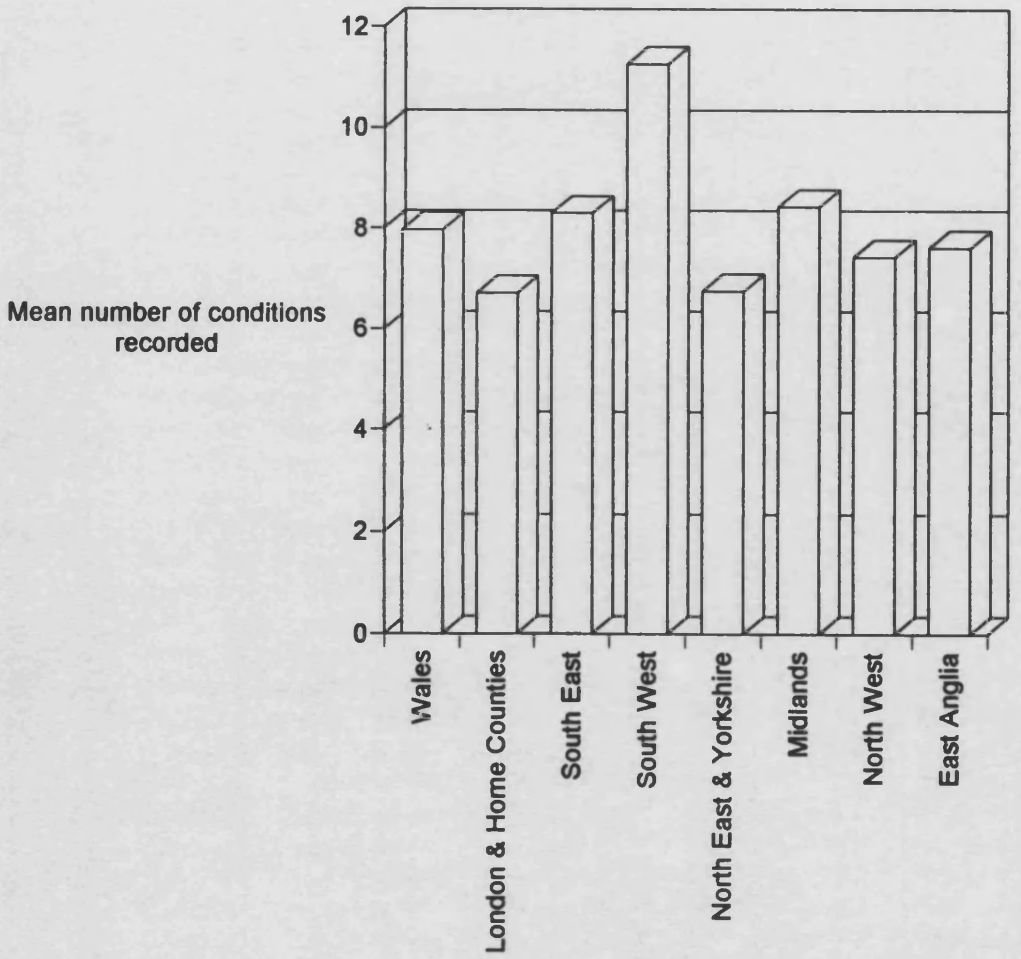


Figure 2.7 shows the effect of the year of registration upon recording of patient conditions. Fisher's LSD test[64] showed that pharmacists qualifying after 1980 recorded more conditions than those qualifying between 1961-65 and 1971-1980 ($p<0.05$). In addition those qualifying between 1966-70 recorded more than those qualifying between 1961-65.

The year of setting up the current PMR system produced interesting data as shown in Figure 2.8, where an almost linear trend is shown. The following results were confirmed by the LSD test, (all $p<0.05$):

1991 > 1986, 1987, 1988, 1989

1990 > 1986, 1987

1989 > 1986

Figure 2.9 shows that there were variations in the number of conditions recorded between users of different computer systems. Fisher's LSD test showed that users of a Park, In-house or AAH system recorded more information about patient conditions than users of Hadley Hutt, Chemtec or Richardson systems ($p<0.05$).

Figure 2.10 shows regional variations in the mean number of conditions recorded. The LSD test showed that the value for the South West was significantly greater than that for London & Home Counties, the North-East & Yorkshire, and the North West ($p<0.05$).

Table 2.24: Percentage of respondents recording specified clinical conditions in their PMR system (national survey, April 1991).

Diabetes	75.9	Renal impairment	27.3
Asthma	69.6	Pregnancy	27.3
Epilepsy	66.9	Drug addict	26.9
Hypertension	48.4	Hepatic impairment	23.4
Cardiac disease	43.0	Skin disorders	21.4
Peptic ulcer	38.0	Cystic fibrosis	17.4
Arthritis	33.8	Depression	17.1
Coeliac disease	33.6	Physical handicap	14.2
Parkinson's disease	32.1	Breast-feeding	13.1
Glaucoma	31.3	Mental handicap	12.8
Confused	30.9	Haemophilia	11.3
Hay fever	29.3	HIV positive	7.2

Table 2.24 shows the percentage of pharmacists recording the patient conditions listed in the questionnaire. Figures 2.4-2.10 show the various parameters which affected the total number of patient conditions recorded in the PMR system. The individual patient conditions that contributed to this variation were determined by cross-tabulating the results in Table 2.24 with the program supplier and with the results about pharmacies and pharmacists presented in Tables 2.1-2.9, using the χ^2 test of independence.[63] Tables 2.25-2.28 show those conditions that contributed to this variation, in order of statistical significance.

Table 2.25 shows that the program supplier produced a significant variation in the level of recording for 16 out of the 24 conditions listed in the questionnaire. Table 2.26 shows that regional location had only a weak influence on the recording of patient conditions, although a higher number of pharmacists in the South West recorded hay fever than in all other regions ($p<0.01$).

Table 2.25: Conditions where program supplier had an influence on PMR recording.

	Percentage of users recording clinical condition								Statistics, df=6	
	Park Systems	John Richardson	AAH	Hadley Hutt	Chemtec	In-house	Others	All users	χ^2	p
Hypertension	76.1	35.2	60.0	16.7	16.7	71.7	36.8	49.9	51.5	<0.001
Cardiac disease	67.4	27.9	57.9	16.7	8.3	60.4	39.6	43.6	49.8	<0.001
Arthritis	58.7	18.0	45.3	25.0	16.7	52.8	24.6	35.0	43.6	<0.001
Confused	32.6	12.3	48.4	25.0	33.3	47.2	26.3	31.0	40.8	<0.001
Parkinsons disease	54.3	16.5	46.3	25.0	25.0	45.3	22.8	33.3	38.7	<0.001
Skin disorders	41.3	9.8	31.9	8.3	0.0	34.0	15.8	22.5	35.7	<0.001
Depression	34.8	5.7	29.5	8.3	0.0	20.8	15.8	18.1	33.3	<0.001
Asthma	91.3	68.9	73.7	41.7	83.3	86.8	54.4	72.5	30.3	<0.001
Hay fever	60.9	22.1	29.5	25.0	8.3	37.7	22.8	30.2	30.1	<0.001
Coeliac disease	60.9	26.2	31.6	33.3	8.3	47.2	24.6	33.8	28.3	<0.01
Epilepsy	84.8	67.2	73.7	33.3	66.7	81.1	52.6	69.5	24.7	<0.01
Glaucoma	50.0	26.2	44.2	25.0	8.3	37.7	22.8	33.8	20.5	<0.01
Peptic ulcer	51.1	36.4	47.4	16.7	8.3	47.2	26.3	39.2	18.5	<0.01
Breast-feeding	8.7	18.9	16.8	0.0	0.0	22.6	3.5	14.4	16.1	<0.05
Diabetes	91.3	75.4	76.8	66.7	91.7	88.7	66.7	78.3	15.4	<0.05
Cystic fibrosis	21.7	9.0	22.1	8.3	16.7	28.8	14.0	17.2	14.0	<0.05

Table 2.26: Clinical conditions for which regional location had an influence on PMR recording.

	Percentage of users recording condition									Statistics, df=7	
	Wales	London	SE	SW	NE & Yorks	Midlands	NW	East Anglia	All users	χ^2	p
Hay fever	34.3	25.5	31.1	55.6	14.3	34.8	26.5	33.3	29.3	20.0	<0.01
Cystic fibrosis	14.3	9.8	24.6	33.3	13.0	16.5	21.7	0.0	17.4	0.0	<0.05
Coeliac disease	28.6	31.4	37.7	63.0	26.0	35.9	31.3	22.2	33.6	14.9	<0.05

Table 2.27: Clinical conditions for which patients' socio-economic group had an influence on PMR recording.

	Percentage of users recording condition						Statistics, df=4	
	AB	C1	C2	DE	Mixture	All users	χ^2	p
Drug addict	8.6	17.6	21.7	36.4	24.1	26.8	20.1	<0.001
Mental handicap	5.2	0.0	34.8	14.0	12.7	12.9	15.6	<0.01
Cardiac disease	25.9	64.7	60.9	43.0	47.3	42.8	13.3	<0.05
Epilepsy	48.3	76.5	78.3	70.4	66.5	66.7	12.2	<0.05
Hypertension	34.5	76.5	60.9	48.9	47.5	48.2	11.4	<0.05
Diabetes	60.3	76.3	87.0	79.0	75.9	75.8	10.2	<0.05
Skin disorders	12.1	41.2	34.8	22.6	19.1	21.3	10.1	<0.05

Table 2.28: Conditions where the year of registration of the pharmacist in charge had an influence on PMR recording.

	Percentage of users recording condition									Statistics, df=7	
	1955 or earlier	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	All users	χ^2	p
Peptic ulcer	23.1	38.7	27.7	27.8	30.4	28.6	51.3	54.7	38.1	26.7	<0.001
Skin disorders	15.4	19.4	6.4	25.9	10.6	15.7	28.2	34.9	21.6	23.4	<0.01
Hypertension	30.8	48.4	34.0	42.6	40.4	42.9	63.3	61.6	48.6	22.9	<0.01
Arthritis	30.8	29.0	21.3	33.3	23.4	27.1	43.0	47.7	34.1	17.7	<0.05
Epilepsy	57.7	61.3	48.9	63.0	66.0	71.4	73.4	77.9	67.5	15.6	<0.05
Depression	7.7	22.6	14.9	14.8	4.3	12.9	22.8	25.6	17.0	15.2	<0.05
Asthma	61.5	67.7	53.2	64.8	70.2	70.0	77.2	80.2	70.2	14.3	<0.05

Table 2.27 shows where the socio-economic group of the pharmacy clientele influenced the recording of patients' clinical conditions. The level of recording of drug addiction increased markedly as the socio-economic ladder is descended. Fewer pharmacies serving the AB socio-economic group recorded details about diabetes and epilepsy than those serving lower socio-economic groups.

Figure 2.7 shows that the pharmacist's year of registration affected the mean number of conditions recorded in the PMR system. The patient conditions contributing to this variation are shown in Table 2.28.

Table 2.29 lists the other patient characteristics and clinical conditions that pharmacists reported they included in their PMRs.

Table 2.29: Number of reported cases of other clinical conditions and patient characteristics as recorded by pharmacists.

10	Thyroid disorders
5	Blindness
4 each	Cancer; Transplant
3 each	Multiple sclerosis; Ostomy; Urinary tract disorders; Deafness; Migraine; Anaemia
2 each	Anorexia; Incontinence; High cholesterol; Housebound; Crohn's disease / Ulcerative colitis; Altzheimer's disease; Menopause
1 each	Myasthenia gravis; Respiratory diseases; Non-compliance with medication; Downs syndrome; Auto-immune disease; Hiatus hernia; Gout; Bowel disorders; No English spoken; Contact lens wearing; CNS disorders; Gluten intolerance

Tables 2.31-2.32 show how pharmacists managed non-current records. The responses in Table 2.31 may be biased since many pharmacists acknowledged that they were not normally informed about a patient relocating. Table 2.32 shows the percentage of pharmacists that recorded details about patient lifestyle. Table 2.33 shows the incidence of pharmacists recording diagnostic test results in PMRs.

Table 2.30: Action taken if patient dies (national and *PILLS*-user surveys, April 1991).

	National survey	*PILLS*-users
Do nothing	169 (39.0%)	41 (50.6%)
Archive record	101 (23.3%)	19 (23.5%)
Print and retain record	38 (8.8%)	2 (2.5%)
Delete all patient details	125 (28.9%)	19 (23.5%)
	433 (100%)	82 (100%)

Table 2.31: Action taken if patient leaves area (national and *PILLS*-user surveys, April 1991).

	National survey	*PILLS*-users
Make a note in PMR	95 (22.0%)	14 (17.1%)
Give printout to patient	20 (4.6%)	6 (7.3%)
Give printout to another pharmacy	10 (2.3%)	1 (1.2%)
None of the above	306 (71.0%)	61 (74.4%)
	431 (100%)	82 (100%)

Table 2.32: Numbers of respondents recording of patient lifestyle details in the national survey (April 1991).

Alcohol consumption	6 (1.4%)
Smoking habits	5 (1.1%)
Occupation	3 (0.7%)
Height / weight	2 (0.5%)

Note: None of the lifestyle factors shown in Table 2.32 were recorded by *PILLS*-users.

Table 2.33: Numbers of respondents recording in-pharmacy diagnostic test results (national survey April 1991).

Pregnancy	22 (5.0%)
Blood pressure	6 (1.4%)
Serum cholesterol	1 (0.2%)

Note: Only one *PILLS*-user recorded blood pressure readings.

No pharmacy from the national survey sample; and only one pharmacy in the *PILLS*-user sample, indicated that patients often asked to see their records as provided for under the Data Protection Act 1984. According to 11.3% of pharmacies nationally, patients rarely requested this (36.6% in the *PILLS*-user group). In 36.4% of pharmacies in the national survey patients were reminded about their rights to access records, compared with 66.7% in the *PILLS*-user survey.

2.3.4 The Recording of Product Information

The recording of details about products is shown in Tables 2.34-2.38.

Table 2.34: Recording of non-prescription medicines (national and *PILLS*-user surveys April 1991).

	National survey	*PILLS*-users
No records	282 (64.5%)	28 (34.1%)
Counter-prescribed medicines	145 (33.2%)	52 (63.4%)
All purchased medicines	10 (2.3%)	2 (2.4%)
	437 (100%)	82 (100%)

Factors that could influence the recording of non-prescription medicines were assessed by cross-tabulating the results from Table 2.34 with Tables 2.1-2.9 and with the system supplier. The only factor which was found to affect the recording of non-prescription medicines was system supplier, where users of the Hadley Hutt *PILLS* system were more likely to record counter-prescribed medicines than users of other systems.

Table 2.35: Percentage of respondents recording of product details for prescribed medicines, dressings and appliances (national and *PILLS*-user surveys, April 1991.)

	National survey	*PILLS*-users
Drug name	99.1	100.0
Quantity	98.9	100.0
Dose	98.9	100.0
Drug strength	98.7	100.0
Dosage form	98.2	100.0
Date of supply	98.0	100.0
Dressing / appliance type	85.2	92.5
Dressing / appliance size	84.5	90.0
Prescribers' name	82.2	95.1
Dressing / appliance re-order code	62.3	72.5
Type of prescription eg. NHS / private	50.5	81.7
Formulae for extemporaneously dispensed products	46.8	46.3
Dressing / appliance supplier	33.7	53.8
Manufacturer of generic products	14.2	2.4
Supplier / wholesaler	9.7	17.1
Expiry date	2.7	6.1
Batch number	2.7	0.0

Note: Computer systems generally record each of the first six entries in Table 2.35 automatically. Some of these values in Table 2.35 were not 100.0% due to manual records being incomplete in this respect.

Table 2.36: Use of PMR systems to maintain oxygen records (national and *PILLS*-user surveys April 1991).

	National survey	*PILLS*-users
Records maintained	146 (33.1)	25 (31.3%)
Records not maintained	93 (21.1%)	21 (26.3%)
Not an Oxygen supplier	202 (45.8%)	34 (42.5%)
	441 (100%)	80 (100%)

2.3.5 The Use of PMR Systems by Pharmacists to Limit the Dispensing of Excess Medication

Respondents' use of PMR systems to monitor for the excessive use of medication is shown in Table 2.37.

Table 2.37: Use of PMR system to limit dispensing of excess medication (national and *PILLS*-user surveys April 1991).

	National survey	*PILLS*-users
Often	78 (17.5%)	18 (22.0%)
Rarely	232 (52.0%)	35 (42.7%)
Never	136 (30.5%)	29 (35.4%)
	446 (100%)	82 (100%)

2.3.6 Labelling of medicines where dosage directions are not stated on the prescription.

The question "*In principle, how do you label medication which is prescribed "as directed", "as before", or where no directions are stated?*" was answered by 692 respondents, comprising 444 pharmacists who used a PMR system (98% of the possible maximum), and 248 non-PMR-users (88% of the possible maximum). Responses to this question were also obtained from 80 pharmacists in the *PILLS*-user survey (96% of the possible maximum). The responses given by each group to the above question are shown in Table 2.38. A total of 131 pharmacists in the national sample replied that they could not give only one response to the question posed, and therefore indicated two or more responses. Where this occurred, the response was classified as *Other action*.

Table 2.38: Labelling of medicines where dosage directions are not stated on the prescription.

	PMR-users	Non-PMR-users	*PILLS*-users
Label exactly as per prescription	146 (32.9%)	152 (61.3%)	12 (15.0%)
Consult patient and label accordingly	52 (11.7%)	59 (23.8%)	6 (7.5%)
Consult prescriber / receptionist and label accordingly	8 (1.8%)	1 (0.4%)	0 (0.0%)
Label with directions held in PMR	107 (24.1%)	N/A	41 (51.3%)
Other action, or a combination of the above	131 (29.5%)	36 (14.5%)	21 (26.3%)
Total in each group:	444 (100%)	248 (100%)	80 (100%)

Applying the χ^2 test of independence to the groups of PMR-users and non-PMR-users in Table 1, showed that the use of a PMR influenced the action taken by pharmacists when labelling prescriptions which failed to specify complete directions, (χ^2=121.26, df=4, p<0.001). Similarly, applyeng the χ^2 test of independence to the groups of PMR-users and *PILLS*-users showed that *PILLS*-users acted differently to other PMR-users when labelling such prescriptions, (χ^2=27.66, df=4, p<0.001).

2.3.7 Patient Information Leaflets

The proportion of pharmacists using computer-generated patient information leaflets is shown in Table 2.39.

Table 2.39: Use of PMR systems producing patient information leaflets.

	National survey	*PILLS*-users
Leaflets used	36 (5.2%)	63 (78.8%)
Leaflets not used	663 (94.8%)	17 (21.3%)
	699 (100%)	80 (100%)

Table 2.40 represents the responses of pharmacists in the national survey to a series of statements about the use of these leaflets. The responses of pharmacists in the *PILLS*-user survey are shown in Table 2.41. The series of statements solicited respondents' views on the use of patient information leaflets to reinforce verbal information; on whether the use of information leaflets affected patient compliance, and whether their use undermined patients' confidence in their prescriber.

The responses from Table 2.40 were cross-tabulated with the results from Tables 2.1-2.9 to examine factors influencing agreement with the statements about leaflets. The Kruskal-Wallis one-way analysis of variance was applied to the cross-tabulated responses. Factors which were found to have a significant influence on pharmacists' views are shown in Table 2.42.

Table 2.40: Pharmacists' agreement with statements about patient information leaflets (national survey April 1991).

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
Patient information leaflets reinforce information given to patients by prescribers	11.3	57.4	25.0	5.7	0.6	100% (n=671)
Patient information leaflets reinforce information given to patients by pharmacists	14.4	69.9	14.9	0.6	0.1	100% (n=672)
Patient information leaflets which give information about side effects may worsen compliance by alarming patients	13.5	58.2	20.6	7.0	0.7	100% (n=674)
Patient information leaflets provide a basis for discussion between pharmacist and patient	6.8	64.4	24.7	3.3	0.7	100% (n=675)
Pharmacists who issue patient information leaflets are at risk of undermining patients' confidence in their prescriber	2.7	18.7	28.1	43.9	6.6	100% (n=669)
More widespread use of patient information leaflets would improve patient compliance	6.4	44.4	35.3	12.3	1.6	100% (n=675)
The use of patient information leaflets reassures patients about their medicine	6.1	45.7	36.5	10.1	1.6	100% (n=674)

Table 2.41: *PILLS*-users' agreement with statements about patient information leaflets (April 1991).

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
Patient information leaflets reinforce information given to patients by prescribers	46.1	35.5	13.2	3.9	1.3	100% (n=76)
Patient information leaflets reinforce information given to patients by pharmacists	53.9	39.5	6.6	0.0	0.0	100% (n=76)
Patient information leaflets which give information about side effects may worsen compliance by alarming patients	8.0	37.3	17.3	30.7	6.7	100% (n=75)
Patient information leaflets provide a basis for discussion between pharmacist and patient	34.2	56.6	7.9	1.3	0.0	100% (n=76)
Pharmacists who issue patient information leaflets are at risk of undermining patients' confidence in their prescriber	5.3	6.6	22.4	34.2	31.6	100% (n=76)
More widespread use of patient information leaflets would improve patient compliance	36.8	35.5	19.7	7.9	0.0	100% (n=76)
The use of patient information leaflets reassures patients about their medicine	25.0	53.9	14.5	5.3	1.3	100% (n=76)

Table 2.42: Factors which influence pharmacists' attitudes to the use of computer-generated patient information leaflets.

	Region	Pharmacy ownership	Pharmacist status	Year of registration of pharmacist in charge
Patient information leaflets reinforce information given to patients by prescribers	$p<0.01$[1]	$p<0.001$[5]	$p<0.05$[11]	ns
Patient information leaflets reinforce information given to patients by pharmacists	$p<0.05$[2]	$p<0.001$[6]	$p<0.01$[12]	ns
Patient information leaflets which give information about side effects may worsen compliance by alarming patients	ns	ns	ns	ns
Patient information leaflets provide a basis for discussion between pharmacist and patient	ns	$p<0.05$[7]	ns	$p<0.05$[16]
Pharmacists who issue patient information leaflets are at risk of undermining patients' confidence in their prescriber	ns	$p<0.001$[8]	$p<0.001$[13]	$p<0.01$[17]
More widespread use of patient information leaflets would improve patient compliance	$p<0.05$[3]	$p<0.001$[9]	$p<0.01$[14]	ns
The use of patient information leaflets reassures patients about their medicine	$p<0.001$[4]	$p<0.001$[10]	$p<0.001$[15]	ns

note: all *H* values corrected for ties
ns=not significant

(Continued on next page)

Table 2.42 (continued from previous page)

1 Pharmacists from Wales and East Anglia were more in agreement with this statement than those from the other regions (H=19.89, df=28).

2 Pharmacists from Wales and East Anglia were more in agreement with this statement than those from the other regions (H=17.66, df=28).

3 Pharmacists from Wales were more inclined to agree with this statement and those from the North East and Yorkshire to disagree. (H=17.13, df=28).

4 Pharmacists from Wales were more inclined to agree with this statement and those from the North East and Yorkshire to disagree. (H=29.76, df=28).

5 Pharmacists from large multiples showed greater agreement with this statement than those from independent pharmacies (H=22.03, df=8).

6 Pharmacists from large multiples showed greater agreement with this statement those from independent pharmacies (H=16.08, df=8).

7 Independent pharmacists tended to disagree with the statement more than the other ownership groups (H=7.32, df=8).

8 Pharmacists from large multiples tended to disagree with this statement (H=18.34, df=8).

9 Independent pharmacists tended to disagree with the statement more than the other ownership groups (H=17.84, df=8).

10 Independent pharmacists tended to disagree with the statement more than the other ownership groups (H=22.17, df=8).

11 Managers agreed with this statement more than proprietors (H=13.27, df=20).

12 Managers agreed with this statement more than proprietors (H=15.78, df=20).

13 Managers disagreed with this statement more than proprietors (H=31.57, df=20).

14 Managers agreed with this statement more than proprietors (H=17.33, df=20).

15 Managers agreed with this statement more than proprietors (H=21.48, df=20).

16 Pharmacists qualifying before 1961 were less likely to agree with this statement than those qualifying in 1961 or later (H=15.78, df=28).

17 Pharmacists qualifying in 1986 or later were more likely to disagree or strongly disagree with the statement (H=20.28, df=28).

The principal findings from these surveys have been published.[65-67]

2.4 Discussion

It is difficult to determine an acceptable response to a questionnaire. The answer depends on the nature of the data being collected and the sample population. The response of 74.4% for the national survey was higher than the figures of 9% and 65% for other similar pharmacy surveys reviewed in the literature.[20,26] Posting a second questionnaire to non-respondents proved highly valuable. Analysing the results from the first 538 responses showed that PMRs were maintained in almost 63% of these pharmacies. In the final analysis 61.5% of respondents maintained PMRs. There were no major differences between pharmacists who replied to the first and second reminder questionnaires. Therefore, the 266 pharmacies that did not respond at all are assumed not to vary significantly from the 744 from which results were calculated.

Sections 2.4.1-2.4.10 relate to findings from the national survey, and Sections 2.4.11-2.4.12 relate to findings from the *PILLS*-user survey and the use of patient information leaflets.

2.4.1 Government Influence on Community Pharmacists' use of PMRs.

The last published paper prior to the presented survey concerning the use of computers in community pharmacy,[26] showed that 25% of a sample of 1 297 pharmacies were maintaining computerised PMRs. In our study, 55.4% of pharmacies had a computerised PMR system in April 1991. Assuming that our sample is representative of all the community pharmacies in the United Kingdom, of which there are about 11 500 registered premises, one can deduce that approximately 3 500 pharmacies have installed a computerised PMR system between the dates of the two surveys. Government payments to pharmacists for the maintenance of PMRs may have been a contributory factor in the large number of pharmacies that had started using PMRs since 1989.

Some pharmacists in the survey who did not maintain PMRs stated that they felt the level of funding to be inadequate. In view of the apparent response to funding provision, these pharmacists would seem to be in a minority. It would appear that Government funding, however meagre, for the use of PMRs may have encouraged pharmacists to accept this aspect of the "extended role" as envisaged in the Nuffield Inquiry Report.[1] The analysis of this hypothesis is more fully discussed in Chapter 3.

2.4.2 Pharmacy Ownership

The low percentage (26.1%) of those pharmacies under locum control that reported the use of a PMR system is of concern. Where there is no regular community pharmacist is in contact with a particular pharmacy's patients, comprehensive record keeping is probably more important than where a regular pharmacist has personal knowledge of patients' medication.

Pharmacists working for large multiples were more likely to believe that PMRs provide financial benefits than those in independent pharmacies or small multiples. This perception is perhaps explained by the fact that management decisions to purchase PMR equipment are made centrally within the large organisations. Promotion of the benefits of PMR systems by large multiples to their employees, coupled with the fact that the employee pharmacist does not receive an invoice for the cost of the equipment, may enhance his opinion of the system. Pharmacists working for independents and small multiples may be in a better position to evaluate the cost/benefit effects of maintaining PMRs. In these circumstances, pharmacists are more likely to have been involved in the decision-making process when evaluating whether or not to use a PMR system and which system to purchase or lease.

2.4.3 Socio-Economic Group (SEG) of Pharmacy Clientele

It is surprising that few pharmacists classified their patients in the C1 or C2 SEGs (Table 2.4). However, some pharmacies classified as having a clientele of mixed SEG may actually belong to the C1 or C2 group. The request that was made to pharmacists to classify their clientele by dominant SEG may well have introduced some subjective bias in the response. Therefore, any results associated with that judgement, which are of marginal significance ($0.01 < p < 0.05$), should be interpreted with caution.

Figure 2.6 shows that pharmacists serving an AB group recorded fewer conditions than pharmacists with a mixed, C2 or DE clientele. This, in some respects, is a surprising observation and would merit further study. There are several possible reasons for this finding. First, a greater morbidity has been claimed among the lower SEGs.[54] Second, patients in the AB group may be more knowledgeable about their conditions than patients from lower SEGs. This may make the AB group more reluctant to disclose their clinical conditions to the pharmacist, and therefore may have some effect on what is recorded. Third, pharmacists serving the DE groups may adopt a more pro-active approach towards their patients, being aware of the possible limitations of a patient's knowledge about his clinical condition. Finally, patients in the higher SEGs may travel more than those from the lower SEGs, and may for example present their prescriptions to be dispensed close to their places of work; conversely those in the lower SEGs may be more likely to use pharmacies close to their home or general practice surgery. The consequence of this is that those patients from the lower SEGs are more likely to take their prescriptions to be dispensed at the same phamacy, thus increasing the opportunity for the community pharmacist to maintain fully-comprehensive records for these patients.

Of the seven conditions that contributed significantly to the variation between SEGs (Table 2.27), epilepsy and diabetes are especially important because of the high incidence in practice. Epileptic patients may move down the socio-economic scale,

due to their condition disabling them from taking many forms of higher-paid employment. In the case of non-insulin-dependent diabetes, inadequate knowledge about the importance of maintaining ideal body weight, through correct diet and regular exercise, may contribute to a higher incidence of this condition in socially deprived areas.

Pharmacies serving the C2 and DE groups recorded mental handicap more often than those serving other groups. At first, this may seem an unexpected finding, but it has been shown that families with handicapped children may move down the social scale. Mental handicap has been reported to be nine times more prevalent among the children of unskilled manual workers than among those in non-manual occupations.[68]

Skin disorders were more likely to be recorded in pharmacies serving C1 and C2 groups than those serving AB and DE groups. Members of the C1 and C2 groups will include skilled and semi-skilled industrial workers, who may be more likely to encounter exposure to potential irritants and sensitising agents in the work environment.

The proportion of pharmacies recording details about drug addicts in their PMRs was 8.6% in the AB socio-economic areas, rising to 36.4% in the DE areas (Table 2.27). This is a very significant result ($p<0.001$) and may reflect a prevalence of drug misuse in socially deprived areas, or an awareness by pharmacists of particular patients who are difficult to manage in the pharmacy.

We were surprised to find that the number of pharmacists recording HIV infection was as high as 7.2%. On examination, most of the pharmacies concerned were found to be located in major conurbations. It is of note that the AAH *LINK* PMR system features a prompt for this condition.

Fewer pharmacies in the AB socio-economic areas recorded hypertension and cardiac disease than those serving lower SEGs (Table 2.27). These conditions are inter-related and a greater morbidity has been shown to exist in the lower social classes.[68] These findings may have implications for community pharmacists as they continue to develop their role in health promotion and diagnostic testing. There may be a special case for community pharmacists serving a DE SEG clientele to consider their role in the provision of health promotion advice, and diagnostic testing services. Government funding for health promotion in community may need to be targeted mainly towards those pharmacies located in socially deprived areas, since by definition, those individuals from a DE SEG have relatively low incomes.

2.4.4 Year of Registration of the Pharmacist in Charge of a Pharmacy

More recently registered pharmacists were found to be more positive about the clinical use of PMRs (Table 2.10 *et seq.*). Figure 2.2 shows that pharmacists qualifying before 1960 are less likely to use PMRs than those colleagues qualifying after 1960. This may be due to a reluctance to use computer equipment[69] or possibly to a more limited knowledge of clinical pharmacy. For example, before the 1960's pharmacy was mainly taught as a two-year diploma course, which became a three-year diploma in 1957. Eventually, a three-year degree course became the sole route of entry to the profession in England, Wales and Northern Ireland.[70] A four year degree course became the sole route of entry in Scotland.

The introduction of degree courses introduced large elements of pharmacology into the undergraduate curricula. Associated with detailed knowledge about the action and use of drugs, graduates would have acquired a greater awareness of therapeutics and the conditions drugs are used to treat. From this one would expect that pharmacists who qualified with a degree from the 1960's onwards would record more patient conditions in the PMR. However, the results are not as simple as this. Figure 2.7 shows that it is

pharmacists who qualified in the 1980's who recorded the most information about patients. This corresponds to the teaching of clinical pharmacy to undergraduates from the mid-1970's onwards.

Figure 2.7 shows that the mean number of conditions recorded by pharmacists who qualified before 1961 appears relatively high. However this graph does not show that the majority of pharmacists in this age group who did keep PMRs at all (Figure 2.2). It is the contribution of a minority of pharmacists in this age group that causes this effect in the results.

Table 2.25 shows patient conditions that contribute to this effect. The most significant finding ($p<0.001$) is that more pharmacists who qualified after 1980 recorded peptic ulceration in their PMRs than those who qualified before 1980. This may be related to the marketing of the first histamine H_2-receptor antagonist cimetidine, in the product *Tagamet* in the UK from November 1976 (Personal communication: SmithKline Beecham PLC). Undergraduate education of pharmacy students would have included the pharmacology of histamine H_2-receptor antagonists from this time. A knowledge of the therapeutics of histamine H_2-receptor antagonists may have raised the awareness of pharmacists qualifying after this time to the prevalence of peptic ulcers, and the iatrogenic cause of many peptic ulcers.

2.4.5 Program Supplier

The market share held by the three major suppliers (John Richardson, AAH, Park Systems) did not alter significantly between 1989-91. However the decisions made by senior management in large multiple companies may indicate a hidden shift in market share. For example, Moss Chemists used the AAH *LINK* system between 1989 and 1992, although subsequently they have been using the *Mediphase* program. This was reflected in an increase in AAH's market share from 14% to nearly 24% during the

period 1989-91. The basis of Boots The Chemists' *APECS* program is a derivative of the program supplied by Park System. However, the Boots *APECS* program is classified here as an "in-house" system: consequently Park Systems' apparent market share in Figure 2.3 does not reflect this.

Figure 2.9 shows that the number of clinical conditions entered in records was influenced by the PMR program supplier. In this respect, practice standards clearly are being influenced by the program suppliers. The results suggest that PMR users fell into two groups. First, those using a system which provided for the recording of clinical conditions by supplying a comprehensive range of clinical condition prompts (eg. Park Systems and AAH *LINK*); in that case, respondents recorded a large number of clinical conditions. Second, where a limited range of clinical condition prompts were provided (eg John Richardson, Hadley Hutt), pharmacists tended to record fewer clinical conditions. There are two implications of this finding: first, pharmacists using those systems with the facility to record a high number of clinical conditions may be better placed than their colleagues without such systems to monitor for contraindicated prescribed and non-prescription medicines; and second, if the facility of recording patients clinical conditions is used more comprehensive pharmacy-held patient record databases will evolve, providing a research resource.

2.4.6 Regional Factors

The overall response to the national survey questionnaire was 74.4%. However there were regional variations in response to the questionnaire ranging from 65.5% in London and the Home Counties to 84.7% in Wales. The low response in London and the Home Counties may have indicated a slightly lower percentage of pharmacies in this region using PMRs than the results suggest.

The regional variation in the proportion of pharmacies using PMRs reflected the results found by workers at Aston University.[26] They found that more pharmacists used computers in the North of England and the Midlands than might have been anticipated.

Our survey results show that pharmacists in the South West recorded a higher mean number conditions in their PMR systems than those from all other regions (Figure 2.10). This is not surprising given the large number of retired people who have moved to the South West. This older population will probably have many chronic conditions requiring regular medication.

One particular condition, unrelated to an elderly population, which made a major contribution to this variation is hay fever (Table 2.26). The author has attempted to correlate regional variations in pollen counts with the data with in Table 2.26. However, no sufficiently detailed pollen count statistics are yet available to perform such an analysis, since the Pollen Research Unit monitors pollen counts from only 10 sites in the UK.[71] However, a report has been published showing higher percentages of hay fever sufferers in the South East and South West than in northern areas of the UK.[72]

2.4.7 Pharmacy Location

It was evident from the results that the place where a pharmacy is sited of the pharmacy does not affect use of PMRs to any significant extent, despite the influence of the socio-economic group of the pharmacy clientele (Section 2.4.3).

2.4.8 Sex of Pharmacist in Charge of Pharmacy

The sex of the pharmacist in charge of the pharmacy was not found to affect any of the responses in the national survey. No variations between the responses of male and female pharmacists were anticipated and the results confirmed this. However, a

subsequent survey showed that the sex of the pharmacist in charge of the pharmacy affected pharmacists' attitudes towards reasons for acquiring a PMR system (Section 3.3 & Figure 3.4).

2.4.9 Manual Records

Table 2.14 shows that, of the pharmacies maintaining PMRs 23.3% kept records for fewer than 500 patients. Most of the pharmacies keeping manual records fell into this category. The Drug Tariff states that payments for PMRs may be granted if 100 patient records are maintained.[60] It is possible that some pharmacies may be keeping a minimum number of records to claim payment for this service.

2.4.10 Recording of Product Information

PMR computer systems have developed from computer labelling systems. They build up records by storing information that is entered as part of the labelling process. Table 2.35 shows that specific details used to produce labels were invariably recorded. However, a disappointingly low number of pharmacists indicated that they recorded information about the source of dispensed medicines. Such information is important in relation to the Consumer Protection Act 1987, and in the rare circumstances of a product recall. Pharmacists are liable for any licence-exempt medicinal products they dispense, including extemporaneous preparations and own [1]*nostrums*. Only a minority of pharmacists in the survey said that they recorded details about the source of medicines or formulae for extemporaneous preparations in their PMR system, despite guidance from the NPA. They may, however, be recording this information elsewhere, for example in the private prescription book or a book of manufacturing records. Very

---

[1]A *nostrum* is a product extemporaneously prepared to the pharmacist's or patient's own formula.

few respondents recorded batch numbers in their records, although the benefits of doing so in case of product recall have been noted.[73]

The majority of pharmacists do not record the supply of any non-prescription medicines in their PMR systems (Table 2.34). At present, there is no specific requirement and, in fact, it may be neither practical nor necessary to record sales of all non-prescription products for all patients. However, there are certain patients for whom such records would be useful. For example, it would be inappropriate for a patient, suffering from a cold, to purchase and use paracetamol tablets in addition to a paracetamol/decongestant cold remedy. The PMR system could warn the pharmacist of such potential overdose situations. A case has been described where a patient was admitted to hospital with hypercalcaemia due to the administration of *Crampex* tablets.[74] The author of this communication noted that few patients had records for or reported the use of non-prescribed medicines on admission to hospital.

2.4.11 *PILLS*-users

Pharmacies operating the *PILLS* system tended to serve patients from higher SEGs than the sample of pharmacies as a whole (Table 2.4).

Hadley Hutt Computing Ltd had not appeared to have supplied many computer systems to large multiple pharmacies in the period to April 1991. In the sample of *PILLS*-users, only 4.8% of the respondents were from large multiples (*cf.* 29.4% in the main survey); the Boots and Lloyds companies have been shown to be using their own in-house systems. The *PILLS* system is typically used by a male proprietor pharmacist in a suburban area, dispensing 400-800 items per week. A comparison of the results in Tables 2.10-2.11 shows that *PILLS*-users are more favourably-inclined towards the use of PMRs than the national sample of pharmacists.

Figure 2.4 shows that for both of our samples of *PILLS*-users (n=13, n=83) records for all prescriptions are maintained by about 70% of all users. This figure was considerably higher than for any other system supplier. Possession of a Hadley Hutt *PILLS*-system was the only factor found to influence whether records were maintained for all dispensed prescriptions; no other factors were found to significantly affect the recording of records for all patients. This finding is reinforced by the results in Table 2.14, showing that the majority (54.9%) of *PILLS*-users have 5000 or more individual patient records. This compared with only 15.8% of the sample of all PMR users. The structure of the computer program determines the number of computer keyboard strokes necessary to switch record keeping on or off. It can be concluded that the method of entering patient and prescription details into the PMR system determines recording of records for patients. In the case of the *PILLS*-system, the keyboard operator must deliberately elect not to record a particular prescription. This shows that program suppliers are determining practice standards for pharmacists.

PILLS-users tended to record more information about prescribers (Table 2.21), and patient allergies/sensitivities (Table 2.22) than other PMR users. However, *PILLS*-users recorded significantly fewer ($p<0.05$) patient conditions in their records than users of Park Systems, In-house or AAH computers (Figure 2.9). Since the April 1991 survey, the ability to record a wide range of patients' clinical conditions was incorporated into the *PILLS* system (August 1991), and consequently the potential existed for this finding to alter. The recording of patients' clinical conditions within *PILLS* systems is further discussed in Chapter 4.

A higher percentage of *PILLS*-users recorded counter-prescribed medicines than users of any other PMR system examined (Table 2.34). This finding, along with the high percentage of *PILLS*-users maintaining records for all patients, would appear to indicate that this system was providing those pharmacists who used it with the most comprehensive record keeping facility available at the time of the survey (April 1991).

Not surprisingly, there are variations between PMR users and non-PMR users in labelling incomplete prescriptions (Table 2.38). However, *PILLS*-users are more likely to use the directions held in the PMR system than the users of any other system. The *PILLS* program is written such that BNF standard doses are incorporated into the drug data file. This is a unique feature among PMR systems. *PILLS*-users have the option of using these directions, or directions stored from a previous prescription. This may explain the high use of PMR held directions by *PILLS*-users.

2.4.12 Patient Information Leaflets

The numbers of pharmacies that produced patient information leaflets are shown in Table 2.39. Some pharmacies using systems other than *PILLS* indicated that they were using leaflets. These pharmacies were either involved in early use of leaflet generating software from Park Systems Ltd. or John Richardson Computers Ltd., or possibly using their own word-processed literature. It is not surprising that the advocates of leaflet generating systems were those who use such systems (Table 2.41).

There are other findings in the attitudes of pharmacists to leaflets that are of interest. Managers of large multiple pharmacies viewed leaflets more positively than other groups, yet this group were less likely to use the *PILLS* system. The use of patient information leaflets is reviewed in Chapter 5.

2.5 Conclusions

1. The results of this survey show that over 61% of community pharmacies in England and Wales were using a PMR system in April 1991.

2. There appeared to be no significant differences in the use of PMRs by pharmacist proprietors and managers. We note with concern, however, that a very low proportion of pharmacies under locum control (ie. with no regular pharmacist present) maintained PMRs.

3. Pharmacists who registered after 1985 were more positive about the clinical advantages of PMR systems.

4. Pharmacists normally included in PMRs all the information that is required to produce a label for a dispensed medicine. Details, regarding the source of the dispensed product were rarely recorded.

5. The use of a PMR system by a community pharmacist increased the likelihood that a patient receives medicines labelled with appropriate dosage instructions. This was a consequence of the directions from a previous prescription being stored in the PMR system. The use of one particular PMR system, *PILLS*, appeared to increase even further the probability that the patient received appropriate directions.

6. Our results showed that there was wide variation in the use of PMRs by community pharmacists to record clinical details about patients. Some pharmacists recorded no details at all, whereas many others recorded a comprehensive range of conditions within their PMRs. By being more aware of patients' clinical conditions, pharmacists can contribute to improved patient

care, for example, by advising against the supply of inappropriate medicines and the use of unsuitable dosage regimens.

7. Practice standards have been set by the suppliers of PMR programs. Where there was the facility to record clinical conditions in response to an on-screen prompt, a considerable number of clinical conditions was recorded. Where such a feature did not exist, few clinical conditions were recorded.

8. Regional variations have been identified in the recording of clinical conditions within PMR systems. The wide range of conditions recorded in pharmacies in the South West of England is probably explained by demographic factors related to the number of senior citizens living in this region.

9. The socio-economic group of patients served by a pharmacy influenced the recording of certain clinical conditions including diabetes, epilepsy and cardio-vascular disorders. A greater percentage of pharmacies serving a DE group clientele recorded patients as drug addicts, than did pharmacies serving other SEGs. These findings indicate that it may be beneficial to target predominantly those pharmacies in socially deprived areas, if future Government funding is allocated to health promotion within community pharmacy.

10. Pharmacists who registered more recently tended to record more clinical conditions than those colleagues who had qualified in earlier years.

3. Reasons For Community Pharmacists Establishing Patient Medication Records

3.1 Introduction

In Chapter 2, it has been shown that there had been a large rise in the number of pharmacies maintaining patient medication records (PMRs) between the end of 1989 and April 1991. That information was obtained by means of a questionnaire sent to 1000 community pharmacies in England and Wales, selected at random from the Register of Premises held by the Royal Pharmaceutical Society of Great Britain. The questionnaire requested information about whether PMRs were used, the systems in use, and the recording of details concerning patients and products.

From the results of the April 1991 study, we identified that 55.4% of the respondents had a computerised PMR system in April 1991. This finding contrasted with the previous figure of 25% of all pharmacies, excluding Boots the Chemists, given by a survey conducted in May 1989.[26] A further 6.1% of the respondents in the April 1991 survey maintained a manual PMR system. One therefore can estimate that about 3500 pharmacies introduced a PMR system between the end of 1989 and April 1991. When discussing those findings, we proposed the hypothesis that the provision of Government funding probably had encouraged community pharmacists to take up this aspect of the extended role. To confirm whether this hypothesis was valid and to elucidate what other factors if any had influenced pharmacists' decisions, we decided to conduct a further survey involving all those respondents who stated that they had installed a PMR system during 1990.

3.2 Method

3.2.1 Equipment and Materials Used

Questionnaire forms and other project documents were produced using Microsoft Word for Windows on a Viglen Genie IBM-compatible computer and a Hewlett-Packard DeskJet 500 printer. SPSS/PC+ V4.0 was used to record results from returned questionnaires and for statistical analysis of the data.[53] A Freepost licence arrangement with the Post Office facilitated the return of questionnaires.

3.3.2 Design of Questionnaire

The survey questionnaire (Appendix 2, page 323) was developed by considering factors that could have influenced a pharmacist's decision to purchase a PMR system, and was designed as an extension of our original national survey (Chapter 2). Therefore a modification to the original SPSS data definition file was written, enabling the new data to be cross-tabulated with results from the original survey.

Other possible factors that could have influenced a pharmacist's decision to install a PMR system were listed, besides the availability of Government NHS funding. These factors included: a desire to provide an improved clinical service, the necessity to update computer equipment, perceived competition from other pharmacies, and sales promotion by the providers of PMR systems. The pharmacists concerned were asked to indicate the extent to which each factor influenced their decision to purchase a PMR system. Seven possible reasons for installing a PMR system were listed in the questionnaire. Respondents were asked to rank each of these on a scale of 1 (very important) to 5 (not relevant / very unimportant). Such rankings produce ordinal data, which can be subjected to non-parametric statistical tests. An opportunity was provided for pharmacists to list other reasons why they had installed a PMR system. Respondents were also asked to indicate how they rated their PMR system on a Likert

scale[75] of 1 (excellent) to 5 (poor). Finally pharmacists were invited to list any features that they would like to see added to their PMR systems.

The results from our original survey had shown that 224 out of a total of 740 respondents (30.3%) installed a PMR system in 1990. Questionnaires were sent to each of these 224 pharmacies at the beginning of December 1991. A second copy of this questionnaire was sent to non-respondents as a follow-up six weeks later.

A parallel survey, using the same questionnaire was also conducted in 63 pharmacies which had installed a Hadley Hutt *PILLS* system during 1990. These pharmacies were those described in Table 2.13.

3.3 Results

A total of 181 responses was received from the 224 pharmacies that were sent a questionnaire (80.8% response). A similar level of response rate was received from 51 pharmacies (81.0% response) in the group of 63 users of the Hadley-Hutt *PILLS* system who were sent a questionnaire.

Responses to the request to rate each of the reasons for purchasing a PMR system on a scale of 1 to 5 are shown in Table 3.1 (national survey) and Table 3.2 (*PILLS*-user survey). Mean scores for the responses to each prompt were also calculated, and are included in these tables. Based on these mean scores, the two most important reasons for installing a PMR system in 1990 were the "need to provide an improved clinical service" and "to keep abreast of professional changes."

Additional reasons for installing a PMR system were indicated by 25 pharmacists in the national survey and 10 pharmacists from the *PILLS*-user survey. In nearly all cases, the reason given was access to drug interaction monitoring software.

Factors that could have influenced the reasons given by different pharmacists were analysed by cross-tabulating the responses in Table 3.1 against the various factors which had been found (Chapter 2) to influence the use of PMRs in our previous survey. The factors evaluated were: the region and location of the pharmacy; pharmacy ownership and clientele; the sex, status and year of registration of the pharmacist in charge; and the supplier of the PMR system. The Kruskal-Wallis one-way analysis of variance[63,64] was applied to the cross-tabulated data to determine the significance of variations within the ranked data.

Competition from other pharmacies was a factor which affected the decision to purchase a PMR system and, as shown in Figure 3.1, the perceived importance depended on who owned the pharmacy concerned (Kruskal-Wallis H=12.60, corrected

for ties, df=8, $p<0.05$). Figure 3.2 shows that this result is mirrored by the status of the pharmacist in charge of the pharmacy (H=11.40, corrected for ties, df=8 $p<0.05$). From these results, it is apparent that managers working for multiples (2 or more pharmacies), especially large multiples (11 or more pharmacies), are more likely than independent proprietors to regard competition as an important reason for purchasing a PMR system.

Comparing the replies from male and female pharmacists (Figure 3.3), more of the latter identified competition as an important reason for installing a PMR system (H=15.66, corrected for ties, df=4, $p<0.01$).

The three factors that were ranked of greatest importance on the basis of the mean scores (Table 3.1) were those most directly related to the professional activities of the pharmacist. They were: the provision of an improved clinical service, enhanced working relationships with GPs and receptionists, and keeping abreast of professional changes. For two of these professional service criteria, the perception as to what extent the factor influenced the decision to purchase a PMR system depended on who owned the pharmacy. Figure 3.4 shows that pharmacists working for large multiple companies were less likely to consider improved relationships with GPs, or their receptionists, an important reason for purchasing a PMR system (H=9.97, corrected for ties, df=8 $p<0.05$). Similarly, Figure 3.5 shows that this group of pharmacists was less likely to purchase a PMR system to keep abreast of professional changes (H=12.10, corrected for ties, df=8 $p<0.05$).

Another finding from the survey was that, of the reasons for installing a PMR system, head office policy was a very important reason in the case of three categories of respondents: pharmacist managers, pharmacists qualifying after 1980 and female pharmacists. Many in these three of the pharmacist categories are likely to be

employed by multiple groups, although no published figures are available to confirm this in relation to all community pharmacists.

Due to the relatively small sample size and homogeneous nature of the *PILLS*-user group, statistically significant variations within this sample were not detected. However, *PILLS*-users expressed particular satisfaction with their PMR system (Figure 3.6).

Pharmacists were asked to rate their current systems on a scale from 1 (excellent) to 5 (poor). Responses to this question are shown in Figure 3.6. By cross-tabulating these responses with pharmacy ownership, determined from our April 1991 survey, and applying the Kruskal-Wallis one-way analysis of variance[63,64], independent proprietors were shown to be more likely than managers to rate their system as excellent (H=14.54, corrected for ties, df=8 $p<0.05$). This finding is illustrated in Figure 3.7

In response to the request to list features that could enhance their PMR system, respondents cited the following in descending order of frequency, the number of responses being given in parentheses: more detail on drug interactions (9), advice on endorsement of NHS prescriptions (5), ability to record the sale of non-prescription medicines (3), information about normal dose ranges (3), electronic link to the Prescription Pricing Authority (3), information leaflet production (2), Martindale On-line (1), ability to record generic manufacturers (1), Interlink[28], and electronic links to GP (1).

Table 3.1: National survey respondents' ranking of reasons for purchasing a PMR system during 1990.

	<Very Important 1	2	3	4	Very Unimportant 5	Total	Mean Score
Availability of NHS remuneration	22 (12.4%)	38 (21.4%)	62 (34.8%)	33 (18.5%)	23 (12.9%)	178 (100%)	3.0
Competition from other pharmacies	46 (25.4%)	49 (27.1%)	37 (20.4%)	28 (15.5%)	21 (11.6%)	181 (100%)	2.6
Head office policy	49 (29.3%)	9 (5.4%)	10 (6.0%)	6 (3.6%)	93 (55.7%)	167 (100%)	3.5
Necessary to update computer equipment	40 (22.7%)	51 (21.9%)	50 (28.4%)	19 (10.8%)	16 (9.1%)	176 (100%)	2.6
Need to provide an improved clinical service	106 (59.6%)	49 (27.5%)	16 (9%)	1 (0.6%)	6 (3.4%)	178 (100%)	1.6
Sales promotion	14 (8.3%)	29 (17.3%)	41 (24.4%)	29 (17.3%)	55 (32.7%)	168 (100%)	3.5
To enhance working relationship with GPs / receptionists	75 (41.7%)	55 (30.6%)	34 (18.9%)	9 (5%)	7 (3.9%)	180 (100%)	2.0
To keep abreast of professional changes	79 (44.4%)	69 (38.8%)	18 (10.1%)	6 (3.4%)	6 (3.4%)	178 (100%)	1.8

Table 3.2: PILLS users' ranking of reasons for purchasing a PMR system during 1990.

	<Very Important 1	2	3	4	Very Unimportant 5	Total	Mean Score
Availability of NHS remuneration	7 (13.4%)	7 (13.4%)	10 (19.6%)	12 (23.5%)	15 (29.4%)	51 (100%)	3.4
Competition from other pharmacies	13 (26%)	10 (20%)	7 (14%)	7 (14%)	13 (26%)	50 (100%)	2.9
Head office policy	1 (2.2%)	1 (2.2%)	7 (15.6%)	0	36 (80%)	45 (100%)	4.5
Necessary to update computer equipment	18 (36.7%)	11 (22.4%)	8 (16.3%)	6 (12.3%)	6 (12.3%)	49 (100%)	2.4
Need to provide an improved clinical service	35 (70%)	11 (22%)	3 (6%)	0	1 (2%)	50 (100%)	1.4
Sales promotion	6 (12.5%)	11 (22.9%)	9 (18.8%)	12 (25%)	10 (20.8%)	48 (100%)	3.2
To enhance working relationship with GPs / receptionists	19 (38.8%)	13 (26.5%)	10 (20.4%)	3 (6.1%)	4 (8.2%)	49 (100%)	2.2
To keep abreast of professional changes	33 (66%)	13 (26%)	3 (6%)	1 (2%)	0	50 (100%)	1.4

Figure 3.1: The effect of pharmacy ownership on the perceived importance of competition in deciding to purchase a PMR system during 1990.

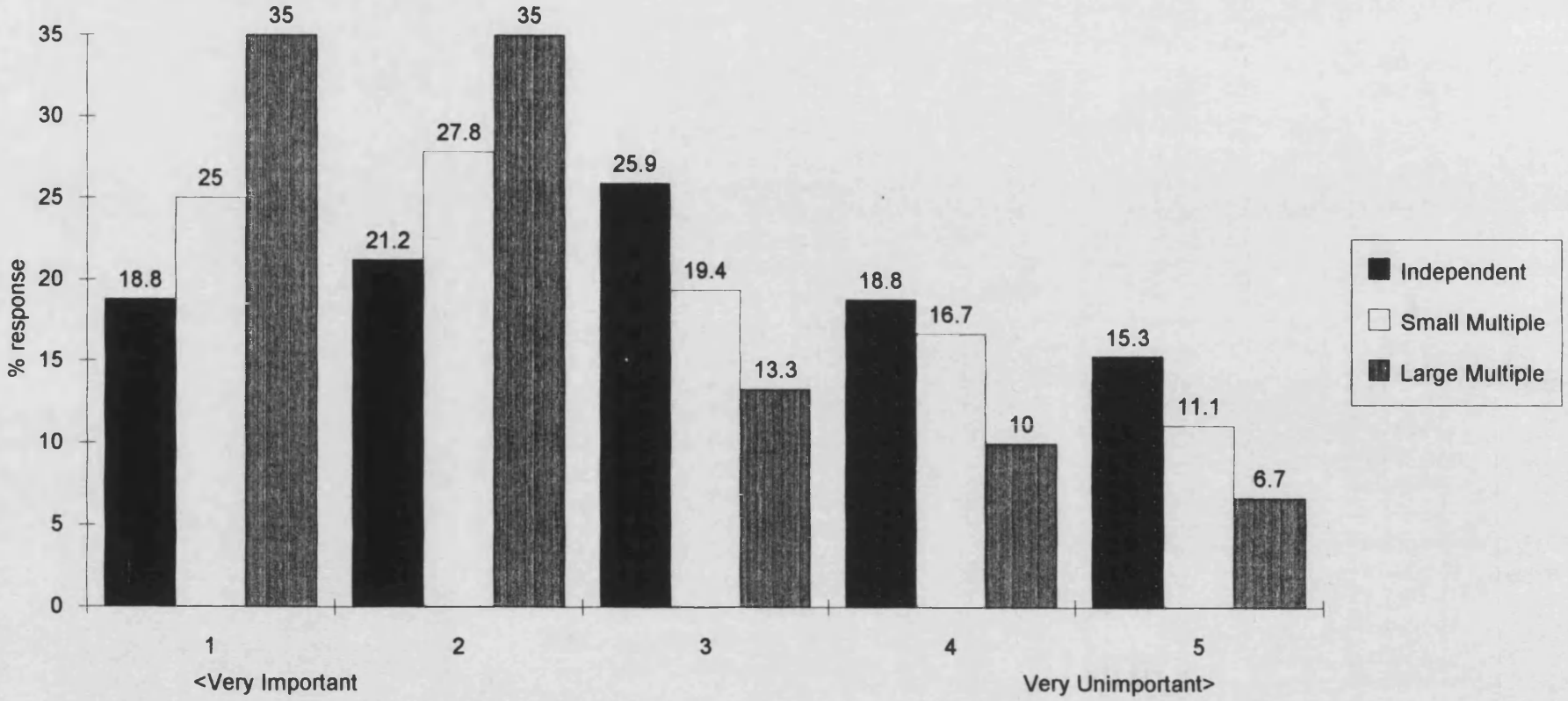


Figure 3.2: The effect of the status of the pharmacist in charge on the perceived importance of competition as a factor in deciding to purchase a PMR system during 1990.

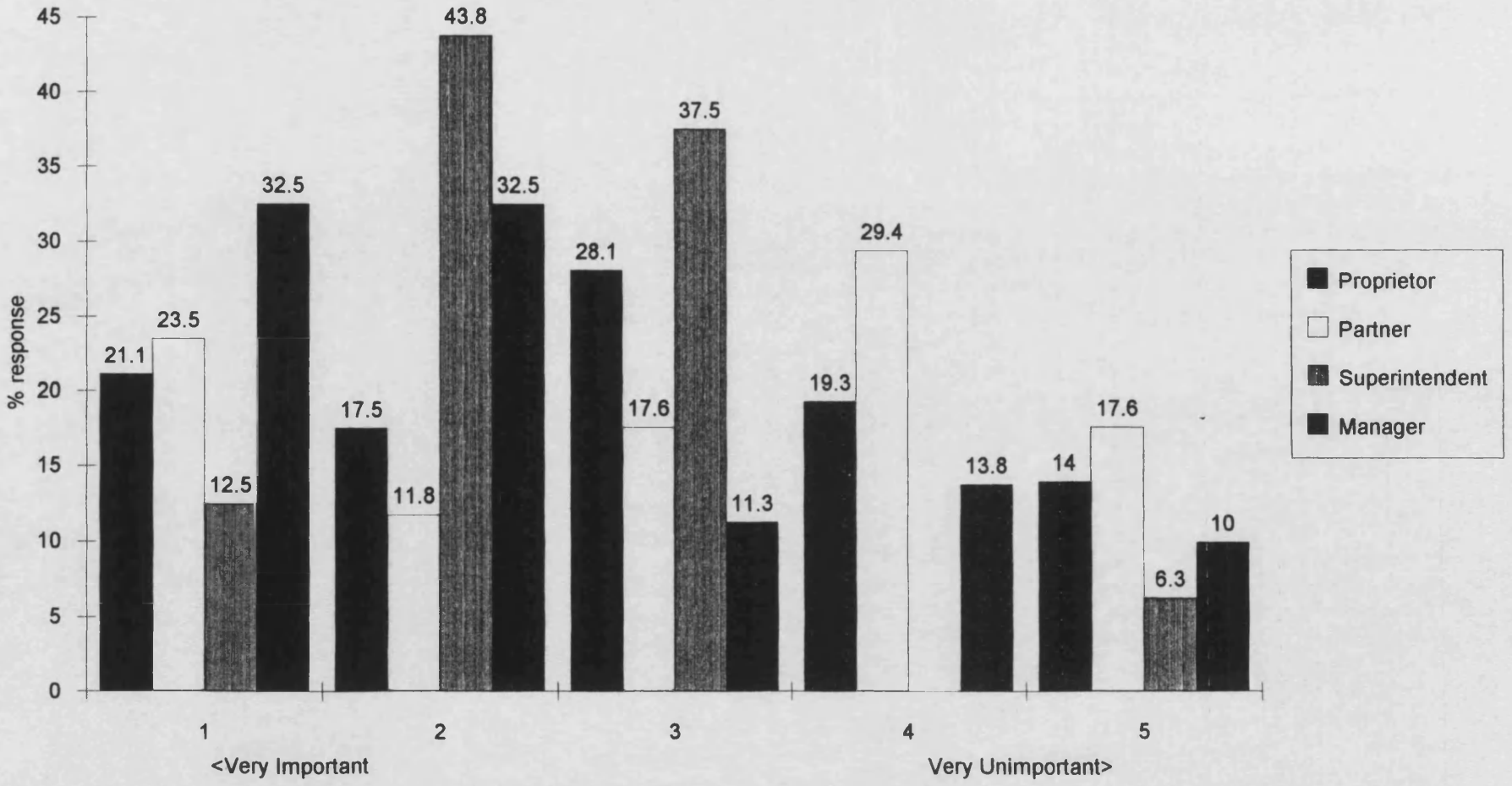


Figure 3.3: The effect of the sex of the pharmacist in charge on the perceived importance of competition as a factor in deciding to purchase a PMR system.

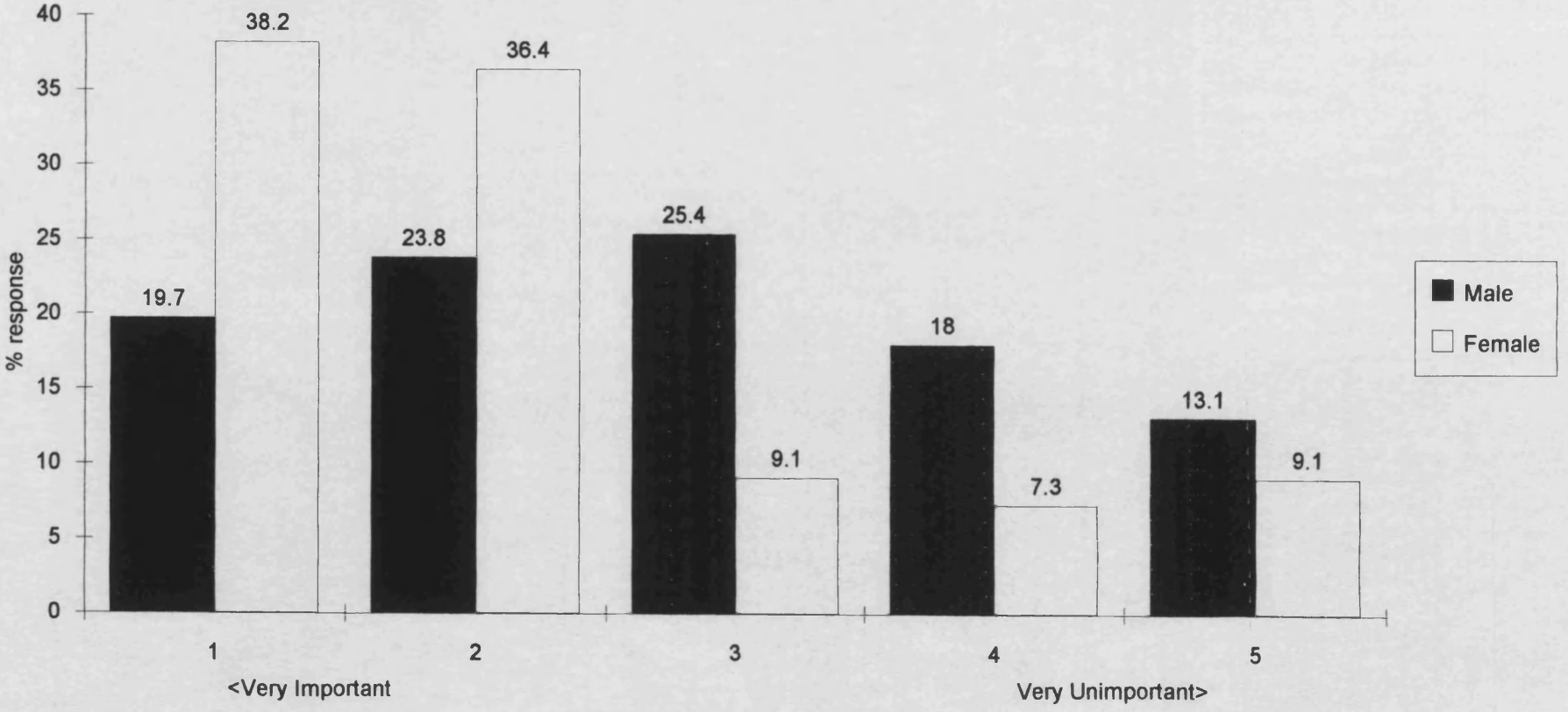


Figure 3.4: The effect of pharmacy ownership on the perceived importance of improving relationships with GPs and receptionists as a reason for purchasing a PMR system.

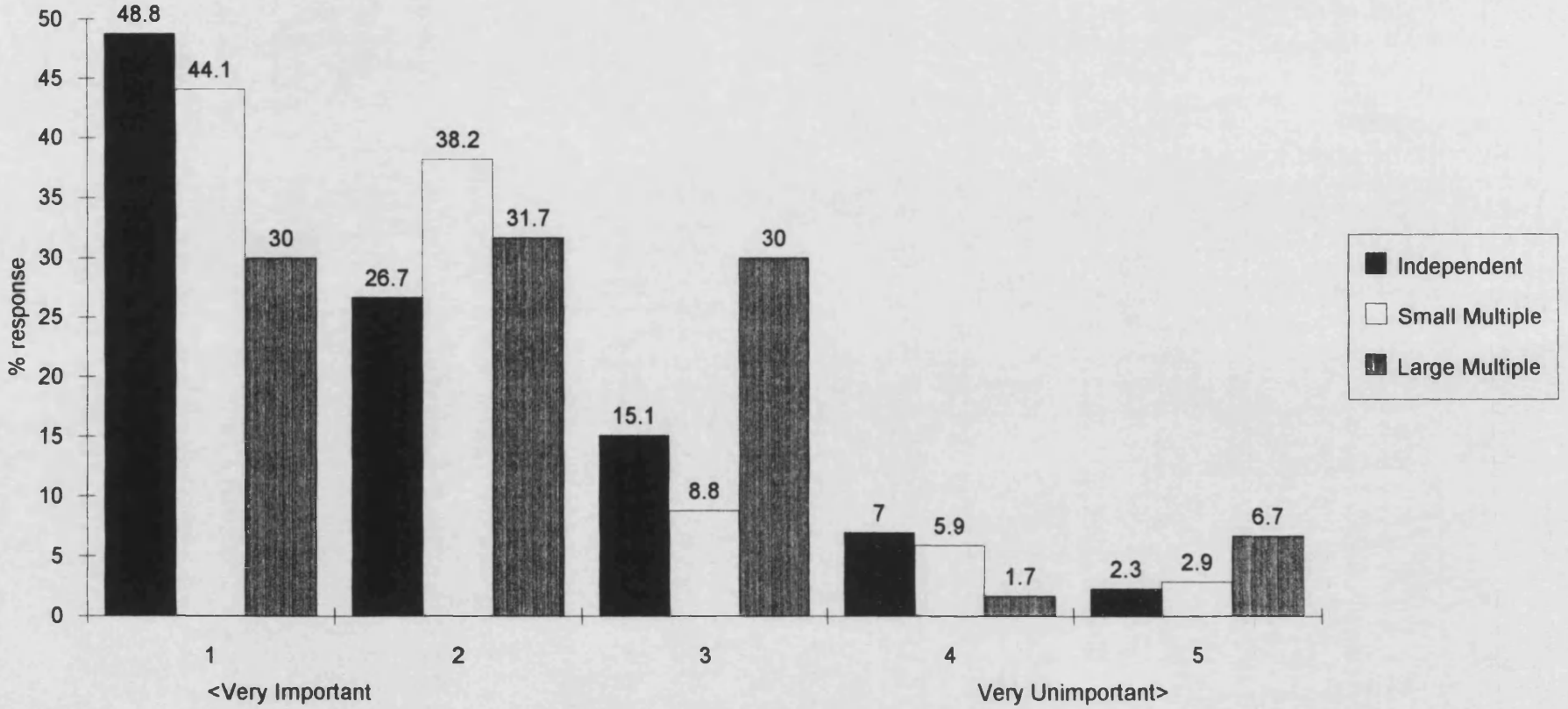


Figure 3.5: The effect of pharmacy ownership on the perceived importance of keeping abreast of professional changes as a reason for purchasing a PMR system.

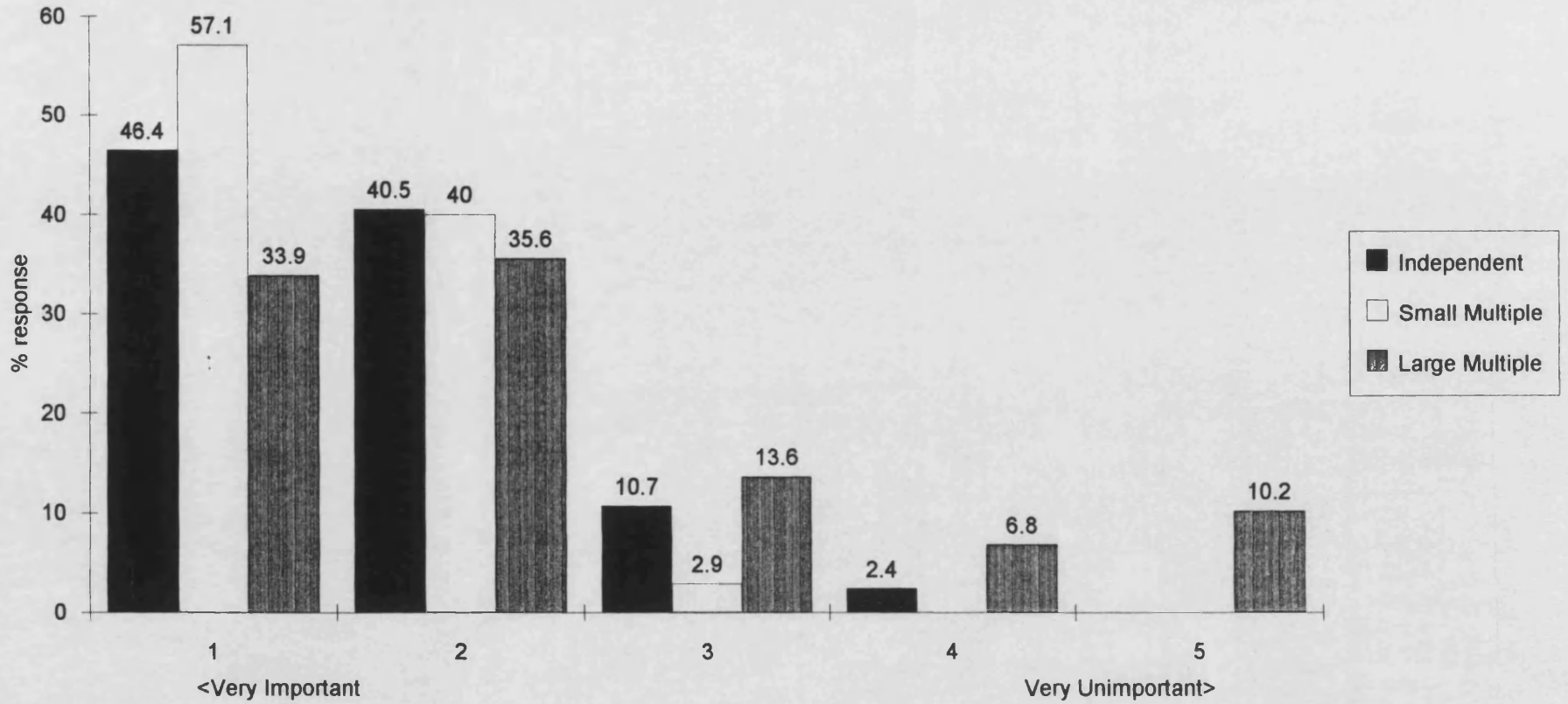


Figure 3.6: Pharmacists' ratings of their current PMR system.

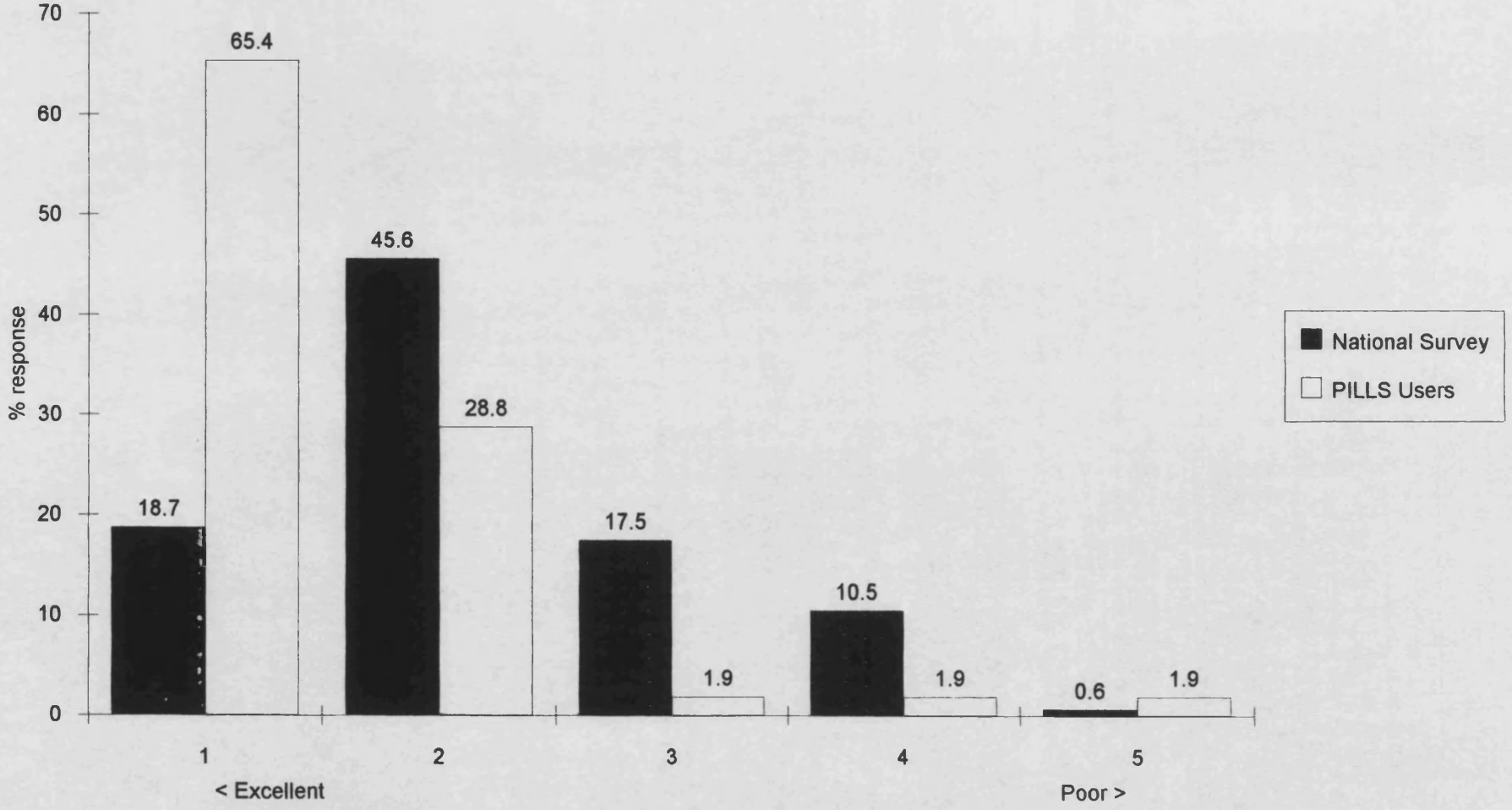
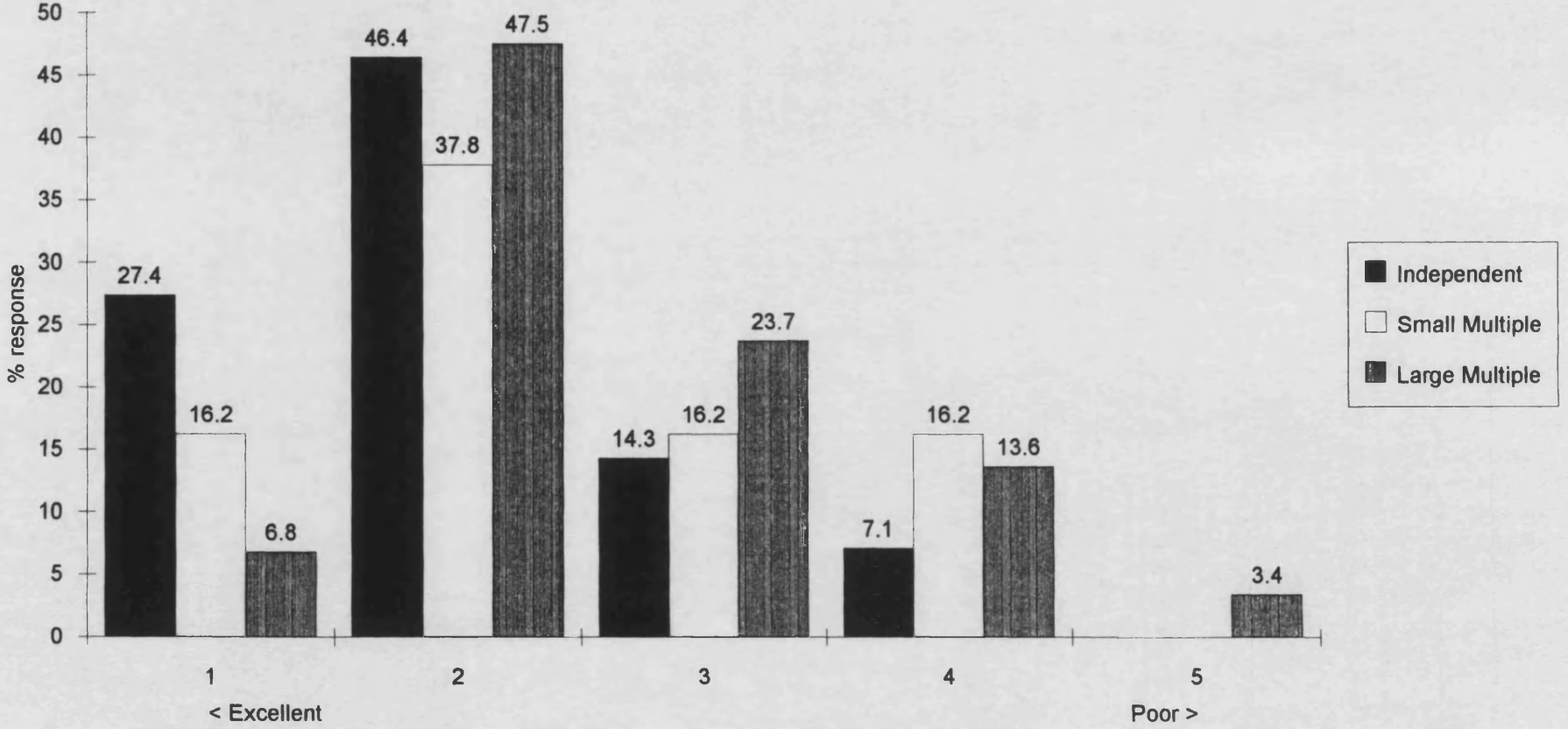


Figure 3.7. The effect of pharmacy ownership on pharmacists' rating of PMR systems.



3.4 Discussion

The survey response of 81% was highly satisfactory. The results have been interpreted on the assumption that the 19% who did not respond would not have significantly affected our findings. Analysis of results before and after the mailing of reminder letters confirmed that the groups of early and late responders did not differ significantly.

A low mean score in Tables 3.1 and 3.2 represents a reason to which most respondents have assigned a high priority when purchasing a PMR system, whereas a high score represents a low priority.

It would appear that our hypothesis that NHS remuneration provided a major stimulus to the installation of PMR systems since 1989 is not supported by these findings. Clearly, the availability of a modest fee payment is a factor that has encouraged some pharmacists to commence using PMR systems, but the influence of this factor seems to have been much less than might have been expected. Only nine pharmacists, among our sample of 181, used manual systems; this small number of respondents indicated that, for them, finance was a very important reason for installing a PMR system, presumably because the cost of a card-file system is only a fraction of that required to purchase a computerised PMR system.

Competition was ranked by 46 respondents as a very important reason for installing a PMR system, and it is evident from Figures 3.1-3.3 that a number of factors underpin this response. Pharmacist managers working for large multiples appeared to view competition as a more important factor in this respect than their independent contractor colleagues. Associated with this effect, female pharmacists ranked competition higher than did their than their male colleagues (Figure 3.3). Some, though not all, of this effect could be accounted for by the fact that female pharmacists

are more likely to be employed by multiple companies than practising as independent contractors.[76]

Head office policy clearly is of concern to pharmacists employed by multiple companies, but is not relevant to independent contractors. This resulted in a bimodal distribution shown in Table 3.1, where most pharmacists ranked head office policy either as very important or very unimportant.

The need to update computer equipment as a reason for acquiring a PMR system, was rated between 1 and 3 by 141 out of 176 PMR users. This, therefore, must have contributed to the increased utilisation of PMR systems. Most computer systems in daily use have a 3 to 5 year life-span. Since the introduction, in January 1984, of the requirement[77] for community pharmacists to produce printed labels, most basic labelling systems would have seen about 4 to 5 years useful life by late 1989 or early 1990. Many such systems would have been due for replacement, and the pharmacists concerned were probably taking the opportunity to upgrade to a PMR system from their basic labelling program. One of the implications of this is that one might expect the next major advances in the application of computer technology in community pharmacy practice to occur in the mid-1990s. Some possible hardware enhancements have been discussed in a recent article.[78]

It is noteworthy that the "need to provide an improved clinical service" was the primary reason cited by pharmacists for the installation of a PMR system (Tables 3.1 & 3.2). This response is reinforced by the perceived importance of a PMR system enabling them "to keep abreast of professional changes". These two reasons were assigned a ranking of 1 or 2 by about 90% of respondents.

The responses from many pharmacists indicated that sales promotion, by system suppliers, appeared to be an unimportant reason for acquiring a PMR system. Clearly

pharmacists working for multiples are required to use the system that is acquired by their employer, in line with company policy, and in those cases sales promotion would not be perceived as a major reason for the selection of a PMR system. There could have been some "brand loyalty" expressed by some pharmacists when upgrading systems; for example, users of the Richardson BBC Micro-based labelling system may have upgraded to the Richardson PC-based PMR system.

Enhanced working relationships with GPs or their receptionists was rated either 1 or 2 by most respondents, and again there are some differences in emphasis between independent contractors and multiples. Figure 3.4 shows that independent proprietors are more likely to give a higher priority to this factor than pharmacists working for multiples, especially large multiples. The reason for this difference in response may be that independent proprietor pharmacists are very dependent on maintaining strong links with particular general practice surgeries near to the pharmacy, whereas in general this is less applicable to city-centre branches of multiples, due to their greater average distance from particular GP surgeries.

The ratings of PMR systems by their users, as shown in Figure 3.6, emphasises the differences between independent contractor pharmacists and those working for multiple companies. Generally, independent contractors will select a system that best meets their practice and commercial needs. Pharmacists in this group rated their PMR systems higher than did pharmacists who used a system provided by one of the multiple companies. Independent pharmacists appeared to be expressing satisfaction with systems that they had selected themselves, but their counterparts working for multiple companies expressed less satisfaction with the systems that had been selected by senior management. In particular, *PILLS*-users expressed high satisfaction with their system. *PILLS*-users are likely to be independent proprietor pharmacists (Section 2.4.11), and as such are likely to have selected the *PILLS* system themselves.

The principal results from this survey have been published.[79]

3.5 Conclusions

1 Pharmacists have installed PMR systems primarily for reasons relevant to the clinical and professional services they provide.

2 Government funding has influenced the uptake of PMR usage, but only to a minor extent.

3 Female pharmacists, and pharmacists working for large multiples perceived competition from other pharmacies to be a more important reason for installing a PMR system than did independent proprietors and male pharmacists.

4 The need to upgrade their computer equipment at the end of its life span was identified by many pharmacists as an important reason for having installed a PMR system. As such, upgrading provided an opportunity to utilise new technology in practice, this may have implications for the next wave of computer systems coming into use after the mid 1990s, when current hardware will become obsolete.

5 PMR users were satisfied with the systems they used, more so in the case of proprietor pharmacists than managers working for multiple companies. *PILLS*-users gave their system a particularly high rating.

4. Further Studies on the Recording of Clinical Conditions Within Patient Medication Record Systems

4.1 Introduction

Two further studies have been conducted on the nature of the recording of clinical conditions within PMR systems. The first of these (Section 4.2 below) piloted a survey of patient conditions recorded in a sample of PMR records maintained by users of the Hadley Hutt *PILLS* system. The second study (Section 4.3 below) comprised an audit of clinical conditions recorded within an "in-house" PMR system used in one branch of a large multiple pharmacy company.

Results from the April 1991 study (Chapter 2) showed that, during the survey period to April 1991, there was a wide variation in the use of PMRs by community pharmacists to record patients' clinical details. Some pharmacists recorded no clinical details at all, yet many recorded a comprehensive range of patients' conditions within their PMRs. There was evidence that current practice standards were being set by the suppliers of PMR programs (Conclusion 2.5.7). It was shown that where there was the facility to record clinical conditions in response to an on-screen prompt, a considerable number of conditions was being recorded. Where such a feature did not exist, few clinical conditions were recorded.

The study showed that the socio-economic group (SEG) of a pharmacy's clientele influenced the recording of clinical conditions including diabetes, epilepsy and cardio-vascular disorders. A greater percentage of pharmacies serving a DE clientele (those reliant on state benefits) recorded patients as drug addicts, than did pharmacies serving other SEGs (Section 2.4.3).

Another parameter which affected the recording of patients' clinical conditions was the year of registration of the pharmacist in charge of a pharmacy. Pharmacists who

registered more recently tended to record more conditions than those colleagues who had qualified earlier (Section.2.4.4).

Regional variations were noted in the recording of clinical conditions within PMR systems. It is possible that the wide range of conditions recorded in pharmacies in the South West of England was explained by demographic factors related to the number of senior citizens living in that region (Section 2.4.6).

4.2 The Recording of Patients' Clinical Conditions Within Hadley Hutt *PILLS* Systems.

4.2.1 Introduction

Each of the above findings were derived from pharmacist respondents indicating those conditions which they recorded in their system; these results however, were not based on the numbers of actual patients recorded as having certain clinical conditions being recorded in the PMR system. It was decided to conduct a survey of PMR users to examine whether the actual numbers of patients with clinical conditions reflected the above findings. The Hadley Hutt *PILLS* system was selected as the PMR computer system to be examined in this study for the following reasons:

i) The response from *PILLS*-users had been satisfactory in the earlier surveys, and it was felt that a similarly good response would be obtained.

ii) Hadley Hutt Computing Ltd. were able to provide a list of all their customers, and were in agreement to the conduct of this survey.

iii) It is straightforward to interrogate the patient database within the *PILLS* system to obtain information about the total number of patient records, and the numbers of patients recorded as having clinical conditions.

A potential disadvantage of surveying *PILLS*-users was that, in the previous study, this particular group of PMR users was identified as one that tended to record few patient conditions (Figure 2.9). However in August 1991, and therefore after completion of the earlier study, the range of clinical conditions which could be recorded in the *PILLS* system has been considerably increased by a modification of the *PILLS* software. A major advantage of the *PILLS* system is that the patient and drug databases are interactive, thus providing the user with a warning of potential drug contraindications for particular specified clinical conditions, for example anti-cholinergics and glaucoma.

Given this enhancement to the *PILLS* software, it was anticipated that the recording of patients' clinical conditions would have increased since the earlier study in April 1991.

4.2.2 Method

The list of 24 clinical conditions, included in the April 1991 questionnaire (Appendix 2, page 311), sent to 1000 pharmacies throughout England and Wales, was modified to produce a series of 29 conditions, thought likely to be recorded by *PILLS*-users in response to patients completing the *PILLS* leaflet number 523; which listed 112 clinical conditions at the time of this survey. A copy of *PILLS* leaflet 523 is included in Appendix 2 (page 327). Clinical conditions rarely encountered by the community pharmacist, for example sarcoidosis and Guillain-Barré syndrome were excluded from the series of 29 conditions.

This questionnaire requested information about the pharmacy's location, the nature of the socio-economic group of most of the pharmacy's clientele, and the year of registration of the pharmacist in-charge of the pharmacy. In addition, the questionnaire requested information as to whether a *PILLS* multi-terminal system was being used. The multi-user variant of the original *PILLS* system was marketed in late 1991, to enable pharmacists to locate more than one labelling and patient medication record computer in their pharmacy. This information about the pharmacy was requested in order to be able to cross-tabulate the data obtained with patient record data.

A list of all pharmacies using the *PILLS* system was obtained from Hadley Hutt Computing Ltd. All *PILLS*-users in Schools of Pharmacy, and those users outside the United Kingdom were excluded from the survey. A copy of the questionnaire shown in Appendix 2 (page 324) was sent to the 418 remaining *PILLS*-users at the beginning of January 1993; all non-respondents were sent a follow-up letter and a second copy of

the questionnaire six weeks later. All coded responses from the returned questionnaires were entered in the SPSS-PC+ V4.0 statistics package.[53]

4.2.3 Results

Completed questionnaires were received from 285 out of the 418 (68.2%) *PILLS*-users in our sample: a similar figure to our earlier response (66.9%) from this group of pharmacists. The results in the tables below are given with the results from the April 1991 survey for comparison. The regional location of respondents is shown in Table 4.1. The year of installation of respondents' *PILLS* systems is shown in Table 4.2.

Table 4.1 Regional location of *PILLS*-users.

Region:	April 1991 survey	January 1993 survey
Wales	5 (6.0%)	22 (7.7%)
London & Home Counties	20 (24.1%)	56 (19.7%)
South East	4 (4.8%)	40 (14.1%)
South West	10 (12.0%)	28 (9.9%)
North East & Yorkshire	6 (7.2%)	31 (10.9%)
Midlands	27 (32.5%)	52 (18.3%)
North West	11 (13.3%)	26 (9.2%)
East Anglia	0	9 (3.2%)
Scotland	0	14 (4.9%)
Northern Ireland	0	2 (0.7%)
Channel Islands	0	4 (1.4%)
Total	83 (100%)	281 (100.%)

Table 4.2: Year of installation of *PILLS* system.

	April 1991 survey	January 1993 survey
1987 or before	3 (3.6%)	2 (0.7%)
1988	3 (3.6%)	4 (1.4%)
1989	15 (18.1%)	31 (10.9%
1990	63 (75.9%)	75 (26.7%)
1991	0	72 (25.6%)
1992	0	97 (34.5%)
Total	83 (100%)	272 (100 %)

A *PILLS* multi-user system was used by 51 respondents; a single terminal system was used by 221 respondents, and 13 respondents did not answer this question. The location of pharmacies in the survey is shown in Table 4.3, with data from the April 1991 survey shown for comparison. The main socio-economic group (SEG) of the pharmacy clientele is shown in Table 4.4.

Table 4.3: Pharmacy location of *PILLS*-users.

	April 1991 survey	January 1993 survey
City centre	5 (6.0%)	29 (10.2%)
Suburban	45 (54.2%)	116 (41.0%)
Village/small town	27 (32.5%)	109 (38.5%)
Health centre	4 (4.8%)	22 (7.8%)
In-store	1 (1.2%)	2 (0.7%)
Other	1 (1.2%)	5 (1.8%)
	83 (100%)	283 (100%)

Table 4.4: Main socio-economic group (SEG) of *PILLS*-users' clientele.

SEG	April 1991 survey	January 1993 survey
AB	16 (19.3%)	40 (14.1%)
C1	3 (3.6%)	11 (3.9%)
C2	5 (6.0%)	17 (6.0%)
DE	24 (28.9%)	89 (31.4%)
Mixture / unable to classify	35 (42.2%)	126 (44.5%)
	83 (100%)	283 (100%)

Table 4.5 shows the year of registration of the pharmacist in charge of each pharmacy where the *PILLS* system was in use.

Table 4.5: Year of registration of the pharmacist in charge of pharmacies where *PILLS* system is in use.

Year of registration	April 1991 survey	January 1993 survey
1955 or earlier	2 (2.4%)	8 (2.8%)
1956-60	6 (7.3%)	16 (5.7%)
1961-65	15 (18.3%)	42 (14.9%)
1966-70	12 (14.6%)	40 (14.2%)
1971-75	8 (9.8%)	34 (12.1%)
1976-80	11 (13.4%)	51 (18.1%)
1981-85	19 (23.2%)	49 (17.4%)
1986-90	9 (11.0%)	36 (12.8%)
1991-2	N/A	6 (2.1%)
	82 (100%)	282 (100%)

Pharmacists were asked to disclose the total number of patient records recorded in their system. This value ranged from 162 to 65 534; a distribution of numbers of records is shown in Figure 4.1. The modal range of patient record numbers was the range 4 001-6 000, with a median value of 7 377. The high numbers of patient records stored within *PILLS* systems according to the earlier survey (Table 2.14) is again reflected in the January 1993 survey.

No patient conditions or allergies whatsoever were recorded by 145 respondents (50.9%). Patients' allergies and clinical conditions were recorded by 139 respondents (48.8%). Of these 139 respondents, 40 only recorded drug allergies and did not record patients' clinical conditions. Therefore only 99 respondents (37.4%) recorded any clinical conditions within their patient records. The total numbers of patients recorded as having the selected clinical conditions in respondents' *PILLS* systems are illustrated in Figure 4.2. In these 99 pharmacies, 16 887 individual entries had been recorded for those 29 patient conditions selected in the questionnaire, with a mean of 170.6 selected conditions having been recorded across all records in those pharmacies where conditions were being recorded. Respondents were asked to state other conditions which were recorded in their records; responses were as follows: gout

Figure 4.1: Numbers of patient records held within PILLS systems January 1993.

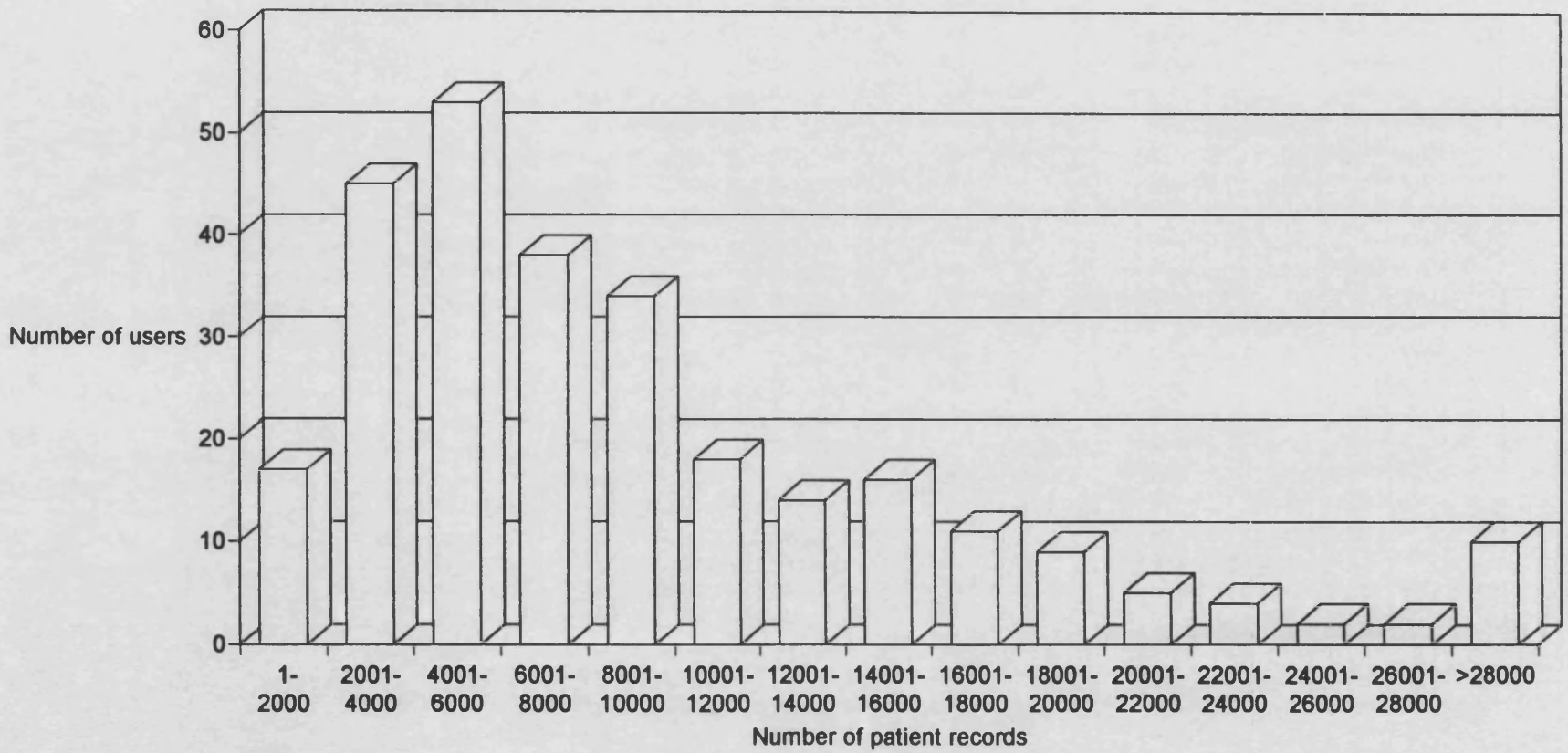


Figure 4.2: Total numbers of patients' clinical conditions recorded within PILLS systems February 1993.

(three), osteoporosis (two), Wolff-Parkinson-White syndrome, pacemaker fitted, children under 12, breast cancer, heart disease (one each). One respondent stated that he had records for 915 patients denoted as "old age pensioners."

4.2.3.1 Hypotheses Testing

Our April 1991 study had verified several hypotheses that several factors influenced what is recorded in PMR systems. The socio-economic group of the pharmacy's clientele (Section 2.4.3), the pharmacists in charge's year of registration (Section 2.4.4), system supplier (Section 2.4.5) and the regional location of the pharmacy (Section 2.4.6) all influenced what was recorded.

An objective of this January 1993 survey was to verify these findings for the population of *PILLS*-users. A method of normalising the January 1993 survey results was developed in order to test whether these hypotheses were true for our sample of *PILLS*-users. A parameter *STD* was calculated as the total number of entries for those 29 clinical conditions specified in the January 1993 questionnaire within an individual *PILLS*-user's system per 1000 patient records stored in that system. The parameter *STD* was an interval/ratio measure and could be examined using standard parametric statistical procedures.

A one-way analysis of variance followed by Fisher's LSD test[64] was performed on the January 1993 survey results to test the hypotheses that the regional location of a pharmacy, the socio-economic group of the pharmacy's clientele, the year of registration of the pharmacists in charge, and the use of a multi-user system influenced what was recorded. No significant effect could be detected at the 5% significance level for any of these factors, using *STD* as the representative parameter.

Our earlier results (Table 2.27) had shown that the SEG of a pharmacy's clientele appeared to affect the recording of the following clinical conditions: drug addiction/abuse ($p<0.001$), mental handicap ($p<0.01$), cardiac disease, epilepsy, hypertension, diabetes, skin disorders, (all $p<0.05$). In the January 1993 survey, of these parameters, a high incidence of the recording of patients as drug abusers had been found in those *PILLS*-users serving a DE SEG (those relying on state pension or social security). By applying the LSD test to the January 1993 survey results, those *PILLS*-users serving a DE SEG were found to differ significantly from those *PILLS*-users serving all other groups ($p<0.05$).

For our sample of *PILLS*-users the variation the recording of patients as drug-abusers was the only clinical condition for which a statistically valid variation could be observed across SEGs. The SEG of the pharmacy's clientele was not found to influence the recording of any other clinical condition. Neither the pharmacist in charge's year of registration nor the pharmacy's regional location were found to influence the recording of clinical conditions for this sample of *PILLS*-users.

4.2.4 Discussion

4.2.4.1 Response

The survey response of 68.2% was similar to the 66.9% response from the April 1991 survey of *PILLS*-users, and was considered satisfactory.

4.2.4.2 Patient Record Numbers

The numbers of patient records held within respondents' PMR systems was considered high, but is similar to our 1991 finding (Table 2.14). The very high numbers of patient records (20 000 and over) reported by some pharmacies (Figure 4.1) is surprising. It is possible that in some cases the quoted figure may be incorrect, even for very busy pharmacies dispensing 2000 or more prescription items each week. A number of possible reasons exist as to why a PMR system may contain multiple records for the same patient. These are as follows:

i) Retention of record under a female patient's maiden name after she has married

ii) New patient record created after a change of address

iii) Multiple records for the same patient under different variations of the same name eg. John Smith, Mr John Smith, John A Smith, John Andrew Smith, Mr John A Smith, Mr John Andrew Smith, Mr JA Smith, J Andrew Smith, Mr J Andrew Smith, JA Smith

iv) Creation of duplicate records. This is very possible with the *PILLS* system, especially when unique patient identification numbers are not used

v) Spelling and typing errors by prescriber, prescribers' receptionist, pharmacist or pharmacy assistant.

It is important that users of all PMR systems are aware of the potential hazards of "duplicate" records which may contain different information; and that when such duplicity exists, a particular record may be incomplete.

4.2.4.3 Recording of Clinical Conditions

The low level of recording of patient conditions was both surprising and disappointing. There are a number of possible reasons for this low level of recording, and these are illustrated by many comments by respondents disclosed on the returned questionnaires. Three respondents stated that they were unaware of *PILLS* leaflet 523 which listed clinical conditions for patients to disclose to pharmacists. Two further respondents were unaware that patient conditions could be recorded within the *PILLS* system. Four respondents complained of there being insufficient time to enter clinical conditions into their systems. Ten respondents stated that they intended to commence recording clinical conditions. One stated that the recent paper by Rogers, Fletcher and Rees[67] had prompted the recording of clinical conditions. One respondent stated that she had recently taken over as pharmacy manageress and that the pharmacy, previously under locum cover, had made very poor use of the patient records. Anecdotally, this supports the findings in Section 2.4.2 regarding the low use of PMRs in those pharmacies under locum control.

Three respondents gave more detailed and pertinent reasons for the difficulty in recording clinical conditions. These were as follows:

i) "The addition of conditions to a patient file has to be done with extreme caution, because what the patient may state may conflict with the actual diagnosis, or the diagnosis that the practitioner has told the patient. The interpretation of interactions or difficulties associated with the inclusion of a condition need to be dealt with (*sic*) extreme caution and tact. Some of the conditions are time-dependent and can expire, eg. pregnancy and lactation."

ii) "Difficult to assign patients to changing conditions, eg. pregnancy. Data should be kept up to date under Data Protection Act Regulations. Patients willing to disclose selective data, eg. gout but not schizophrenia."

iii) "We generally view a patient's medication profile to arrive at our own judgement of which conditions, and the degree of severity which is relevant."

Two of these quotes (i & ii) discuss problems with conditions considered to be transient, eg. pregnancy. There is probably a case for the suppliers of PMR systems to provide an on-screen prompt at a specified time to check whether such a clinical state still applies. At the time of writing (May 1993), Park Systems Ltd. have just introduced such a feature into their system.

The first quote raises the problem of whether the patient's interpretation of their condition is the same as their prescriber's diagnosis. This is an extremely important issue if pharmacy records are to be relied upon to detect product contraindications. It is important for the pharmaceutical and medical professions to discuss how conditions should be recorded within pharmacy records. This subject is discussed further in the survey of GPs' attitudes to pharmacy-held PMRs in Chapter 9.

One *PILLS*-user felt that clinical conditions would be better recorded on smart cards. Certainly the use of a smart card, containing clinical details, could resolve the problem. However the use of smart cards in England and Wales is not being actively pursued by the Department of Health at present, due to the failure of the Exmouth Project to demonstrate any significant benefits from their use[41], although a new trial is taking place in Scotland.[42]

Clearly, from the respondents' comments in this January 1993 survey of *PILLS*-users and the low reported use of the *PILLS* system to record clinical conditions, there is a

need to examine how this feature could be better utilised. One respondent stated that input of conditions from an on-screen menu (*cf.* Park Systems) would be a much better method of recording relevant information.

4.2.4.4 Confirmation of Earlier Hypotheses

The findings from the January 1993 survey of *PILLS*-users support only one of our earlier hypotheses, which is that the SEG of a pharmacy clientele influences the recording of patients as drug abusers or addicts. This survey has shown that pharmacies serving a DE clientele are more likely than those serving other groups to record drug abuse ($p<0.05$). This supports the finding from our initial survey in April 1991 survey ($p<0.001$) that the recording of drug abuse increases as one progresses down the socio-economic scale.

There are two possible reasons why all other findings were not statistically supported by this further survey of *PILLS*-users. The very limited recording of clinical conditions by the majority of the respondents in this survey makes it very difficult to obtain meaningful comparisons, which will withstand rigorous statistical tests.

A second possible reason is that our April 1991 survey was a representative sample of all pharmacies using a wide variety of PMR systems, but this January 1993 survey has been conducted on a sub-sample, estimated to include approximately 5% of all PMR-users. The nature of *PILLS*-user respondents in the April 1991 survey has been described in Section 2.4.11. Tables 4.1-4.5 show that there have been no major changes in the nature of *PILLS*-users since April 1991, in terms of the factors found to have an influence in the April 1991 national survey: regional location, SEG of pharmacy clientele, and year of registration of the pharmacist in charge. In the April 1991 study, it was shown that the sub-sample of *PILLS*-users was not representative of the total population of PMR users (Section 2.4.11). Therefore direct comparisons

between the national survey in April 1991 and the January 1993 survey of *PILLS*-users become very difficult. It might have been better to have conducted this later survey among a broader sample of PMR-users. However, that would have created additional problems as it is not possible to interrogate the patient databases within most suppliers' systems to obtain the data that was required for this survey.

It is not considered that Conclusions 2.5.8-2.5.10 have been disproved by this survey, given the differences between the PMR-user sub-sample in this January 1993 survey of *PILLS*-users and the sample of PMR users taken from the total PMR-user population in the April 1991 survey. This is despite not being able to show that the recording of patients' clinical conditions was influenced by the pharmacy's regional location, year of registration of the pharmacist in charge, or the SEG of the pharmacy's clientele, other than recording of drug abuse being influenced by the SEG of the *PILLS*-user's clientele.

4.3 An Audit of Clinical Conditions Recorded in the PMR System at One Branch of a Large Multiple Pharmacy.

The support of Miss Katherine Smith is acknowledged for her assistance in data-gathering for Section 4.3. Miss Smith undertook this work under my supervision, as part of an undergraduate project.

4.3.1 Introduction

The recording of patients' clinical conditions in PMR systems has been described in Chapter 2. One benefit of recording that information is that community pharmacists are better able to monitor the prescribing of both contraindicated prescribed and non-prescription medicines, and intervene if a particular product is unsuitable. This is facilitated further if a PMR computer system in use, such as the Hadley Hutt *PILLS* or Park Systems' program, can automatically detect drug-condition incompatibilities.

There were three objectives in undertaking this study. First, to assess, in some detail, the potential of using a PMR system to record patients' clinical conditions within a single community pharmacy. The second objective was to enable a comparison of the levels of clinical condition recording between the *PILLS* system and an "in-house" system known to be capable of recording a wide range of conditions (Figure 2.9). A third objective of the survey was to compare the incidence of recording of clinical conditions in the community pharmacy PMR system with national morbidity data.[80]

4.3.2 Method

A medium-sized branch of a large multiple pharmacy company was selected for this survey. The community pharmacy concerned is located in the high street in a small town in Avon, with a population of about 20 000. A computerised PMR system had been in operation at this pharmacy since May 1991. It is the normal practice at this pharmacy to counsel patients (or their parent or representative) on the purpose of the

PMR system, and to provide a patient questionnaire requesting details about the patient, their general practitioner, and any drug allergies or any chronic clinical conditions that they had. Details from the returned patient questionnaires are subsequently entered in the computerised PMR system, and the questionnaires archived.

All patient questionnaires returned prior to the date of this study (February 1993) were scrutinised and each patient's clinical conditions anonymously entered in a Microsoft Excel database, which enabled cross-tabulation and statistical examination of associated clinical conditions, using the SPSS-PC+ V4.0 statistics package.[53] No patient names, addresses or other particulars were recorded during the survey. Patient medication histories were not examined.

4.3.3 Results

At the time of this retrospective survey (February 1993) there were 7429 patient records stored in the system. Completed questionnaires had been returned by 1895 patients (25.5% of all patient records). The numbers of patients suffering from recorded clinical conditions, and allergies to penicillin and aspirin, are shown in Figure 4.3. Several other conditions were recorded for single patients only, eg. Wolff-Parkinson-White syndrome, ankylosing spondylitis, carpal-tunnel syndrome and house dust-mite allergy. These are not shown in Figure 4.3.

Applying the χ^2 test of independence[63] to cross-tabulated conditions showed that certain conditions were associated with each other, as follows: asthma and hay fever, asthma and eczema, hay fever and eczema (all $p<0.001$), and diabetes and cardio-vascular disorders ($p<0.01$).

A comparison of the incidence of the recorded clinical conditions with national morbidity data[80] is shown in Figure 4.4. If the ratio of the recording of each clinical condition within the PMR system matched that found in national morbidity data, the two lines on Figure 4.4 would overlap. Where the incidence of recorded clinical conditions is higher than one would expect from national data, the pharmacy plot would be above the plot for national morbidity data, and vice-versa.

Figure 4.3: Frequency of the recording of clinical conditions in the PMR system at one branch of a large multiple pharmacy.

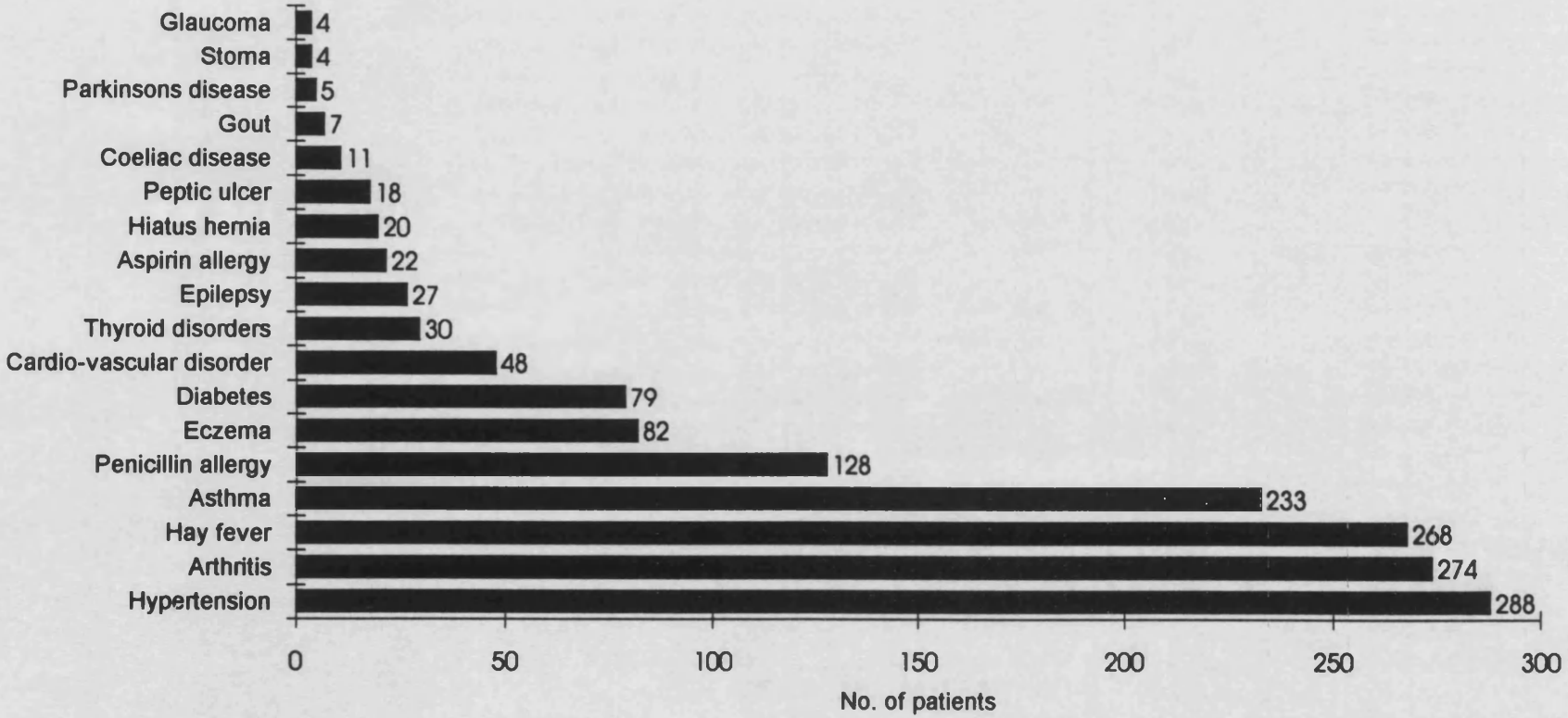
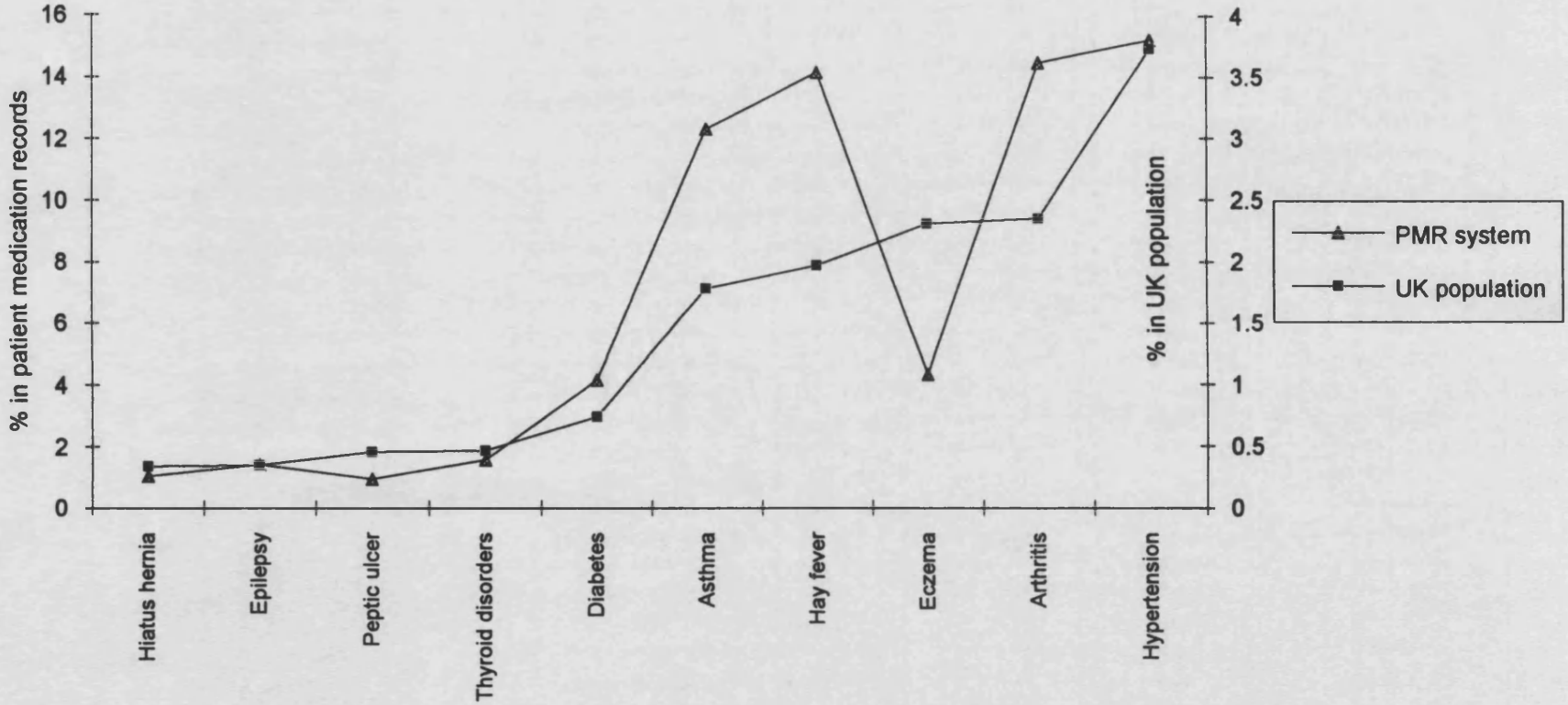


Figure 4.4: Percentage of patients in the medication records held at a branch of a large multiple pharmacy noted as having certain clinical conditions, compared with the UK population as a whole.



4.3.4 Discussion

Although the percentage of questionnaires returned by patients could be considered low, the level of reporting of clinical conditions by patients (25.5%) confirmed the potential for the use of PMRs in community pharmacy as a clinical database to monitor for contraindicated prescribed and non-prescription medicines. For example, 15.6% of all patients returning questionnaires claimed to be hypertensive and 14.5% claimed to be asthmatic. Hypertension, asthma, diabetes mellitus, epilepsy, peptic ulcer and glaucoma are all examples of conditions in which certain drugs are contraindicated.[81] Clearly, the community pharmacist has a vital role to play in monitoring for the use of contra-indicated drugs. Such use of PMR systems to monitor for the use of contra-indicated prescribed and non-prescription medicines is discussed in Chapter 7.

Figure 4.4 shows that a higher number than expected of patients at the study pharmacy were recorded as suffering from asthma and hay fever; indeed 89 patients (4.7% of those returning a questionnaire, 1.2% of all patient records) were recorded as suffering from both conditions. This is possibly a reflection of a high incidence of hay fever in the South West.[72] The recording of patients suffering from eczema appeared low, possibly due to a low perception of the importance of this condition, especially in mild cases, by patients. If this was true, patients may feel that suffering from eczema has no relevance to their medication profile, and therefore there was no need to report this to their community pharmacist.

The number of patients recorded as suffering from arthritis was high, reflecting the large number of elderly patients who collect regular medication from this pharmacy. It is also possible that the high incidence of the recording of arthritis could be due to a high level of awareness and easy access to Rheumatology consultants at the Royal National Hospital for Rheumatic Duseases in Bath, which is only seven miles from the

pharmacy concerned. For each of the other clinical conditions examined, the incidence of recording each condition within the PMR system was broadly as would be expected from national morbidity data.

For community pharmacists, there could be some advantages in conducting an audit of the clinical conditions recorded in their PMR systems, where such patient information is routinely recorded. This survey has shown that examining the profile of clinical conditions recorded within a community pharmacy's PMR system could provide a method of studying that pharmacy's client population. The information so derived could be used in planning future patient services and product inventories; for example, if the pharmacist finds that he has a large number of arthritic patients there could be a case for the inclusion of an appropriate range of aids for the disabled in his stock inventory.

4.4 General Comment

Although the records from only one branch of the large multiple pharmacy company were audited, these two surveys appear to confirm that the recording of patients' clinical conditions within PMR systems is still highly system-dependent (Sections 2.4.5 & 4.2.4.3). However, following modification of the *PILLS* software there is now greater scope to record clinical conditions within the *PILLS* system than within the "in-house" system used by the large pharmacy multiple company, unlike the prevailing conditions when the original surveys were undertaken in April 1991 (Chapter 2). Therefore, factors in addition to the computer software must be influencing what is recorded. As stated in Section 4.3.2, it is normal practice within branches of the pharmacy multiple concerned to issue a questionnaire to patients, including a request for details of the patient's clinical conditions. This study has shown that, although only a relatively low percentage of patients returned the questionnaires, a considerable amount of patient data had been received by the study pharmacy and consequently

entered into the PMR system. In contrast, several *PILLS*-users have stated reasons why the recording of patients' clinical conditions has been limited (Section 4.2.4.3). Clearly, there is a need to evaluate the best way for community pharmacists to obtain accurate and relevant information on patients' clinical conditions. Such methods would need to be agreed and developed with the medical profession. This is further discussed in Section 9.4.4.

4.5 Conclusions

1. Users of the Hadley-Hutt *PILLS* system tend to record few details about patients' clinical conditions, despite an enhancement to the *PILLS* software. Some users of this system are still unaware that clinical conditions can be recorded as part of a patient's record. There is a need to ensure that PMR systems' ability to record a patient's clinical conditions are better utilised by *PILLS*-users.

2. The recording of patients as drug-abusers by pharmacists using the *PILLS* system is dependent on the socio-economic group of the pharmacy clientele. The highest relative incidence of recording patients as drug-abusers was found in those pharmacies serving a clientele from the DE SEG.

3. Audit of patient's clinical conditions, using data held in PMRs may enable pharmacists to have a better understanding of their client population. This could have implications for the provision of improved services by community pharmacies.

5. Patient Information Leaflets

5.1 Introduction

In community pharmacy practice it can be considered that patients receive information with dispensed products in at least one of four ways: advice from prescribers and their staff; directions written on the product label; verbal advice from pharmacists and their assistants; and from patient information leaflets. Studies have shown that patients' recall of spoken information is often limited, hence a need for the provision of a written reminder.[82] In this chapter, the use of patient information leaflets is described briefly and the results are presented of two studies on the use of information leaflets produced by the Hadley Hutt *PILLS* system.

5.1.1 The Use of Patient Information Leaflets

It is important that patients understand relevant information provided to them on information leaflets. Davis has shown that there is a gap between patient comprehension and the readability of certain patient education materials.[83]

Sutton *et al* have shown that patients want information leaflets to include illustrations and simple information on side effects, interactions, dose and the effect of missed doses.[84] In Italy, Miselli and co-workers showed that consumers preferred experimental leaflets produced by a group of clinical pharmacists over standard package inserts approved by the Italian Ministry of Health.[85] Miselli's group claimed that there was a need to develop an improved consumer-oriented language for widely used drugs.

In the UK, most of the recent work assessing patient information leaflets has been conducted by Professor George's research group at Southampton University.[86-90] They have shown that patients want and need more information than they received from doctors and pharmacists.[86,87] Furthermore, they showed that patients who

received information leaflets knew more about their medicines, especially any associated side effects. In a survey of 3410 patients recruited at 254 pharmacies, Gibbs *et al* showed overwhelming public support for the use of patient leaflets, and also demonstrated significant improvements in patients' knowledge about their medicines.[88] In general, they found that side effects were not reported any more often by patients who were given leaflets than by those who were not. However, for one group taking β-adrenoreceptor antagonists, patients given leaflets were more likely to report sleeplessness, vivid dreams, itching and rashes.

The effect of patient information leaflets on compliance is unclear. Despite the improvements in patients' understanding of their medication, information leaflets have not actually been shown to improve patient compliance. In fact, anecdotal evidence exists to show that providing patients with information about side effects may lead to non-compliance with a prescribed regimen.[91] In a survey of 1218 patients using inhaled bronchodilators, Gibbs could not produce evidence to show that patients who received information leaflets were more compliant than those control patients who did not.[89] In a much smaller survey of 68 patients, Dodds showed that, in the absence of any counselling from pharmacists, patient information leaflets improved compliance in patients receiving antibiotic therapy.[92]

Kitching has reviewed the use of patient information leaflets.[93] In his paper, he described the use of readability formulae and made 16 recommendations for the improvement of a text's comprehensibility. In addition, he listed the effects that typographical layout may have on well-written and readable information, making a further 12 recommendations on typography.

5.1.2 Leaflets Produced by Pharmacy Computer Systems

Leaflets can normally be provided to patients in one of three ways. First, it is now common for original packs to contain an information leaflet. Indeed, the EEC Council has proposed that leaflets should be included in all original packs of products that are introduced or require product licence renewal after 1 January 1994. This was enacted by Parliament in January 1993.[94] The ABPI has produced a definitive document on those details that should be included in patient leaflets.[95] The purpose of these industry-produced leaflets is to reinforce and amplify information given to patients by pharmacists and doctors. The use of package inserts, and some of the problems associated with them, have been described by Griffin.[96] He identified the key problem with the use of package inserts in the UK as original pack dispensing not being the norm. A further problem, described by Raynor, is that, since original packs should be dispensed intact to patients, pharmacists are not able to use their professional judgement as to whether the package insert is appropriate for a particular patient.[97]

A second type of information leaflet is that provided by pharmacists as an adjunct to advice. Commonly, these are non-product-specific and deal with dosage forms with which patients may be unfamiliar, eg. eye drops and suppositories. Typically, these leaflets will contain illustrations on how to use a particular dose form.

The third method of supplying leaflets to patients is by means of the pharmacy computer system, a method pioneered by Hadley in the mid-1980s in the UK.[98] Our 1991 survey identified that three UK suppliers of pharmacy computer systems (Hadley Hutt, Park Systems and John Richardson Computers) offered leaflet production as an optional feature on their system (Section 2.4.12). In Chapter 6, it will be shown that many pharmacy computer systems used in the USA have a facility to produce patient information leaflets (Table 6.4). A recent paper has described the use in Finland of a computer-based drug information system *ELLI*.[99] This system integrates with

software used to process prescriptions, and is capable of producing leaflets about the effects, adverse effects and proper use of dispensed medicines.

5.2 Assessment of the Readability of Leaflets Produced by the Hadley Hutt *PILLS* System

5.2.1 Methods of Assessing Readability

Certain patient information leaflets have been criticised for being either too simple or too complex.[89] In particular, original-pack leaflets enclosed with oral contraceptives have been singled out for criticism.[89,90] Such leaflets have been described as being written in a style, and with such detail, that only a biological sciences graduate could understand them.[90] George stated that leaflets should be written using simple words and avoiding jargon.

Readability is the measure of the ease (or level of difficulty) with which a text can be read and understood.[100] Several readability indices exist to assess numerically the readability of a text. Readability indices are usually based on regression formulae.[93] Examples are the Flesch Formula (Flesch Reading Ease Score), the Dale-Chall Formula and the SMOG grading.[32] One of the most commonly quoted formulae is the Flesch Reading Ease score[101], which is calculated on a scale of 0 (very difficult) to 100 (very easy), and is calculated using the following equation:

$$\text{Reading Ease} = 206.8 - 0.846W - 1.015S$$

where W=Number of syllables per 100 words, S=Average number of words per sentence.

The interpretation of calculated Flesch Reading Ease scores is shown in Table 5.1.

Table 5.1: Interpretation of Flesch Reading Ease scores.[32]

Reading ease score	Verbal description of score	Estimated percentage who would understand document with given score:	
		Aged 25+	Aged 75+
90-100	Very easy	97	91
80-90	Easy	95	88
70-80	Fairly easy	90	77
60-70	Standard	90	77
50-60	Fairly hard	77	50
30-50	Difficult	31	17
0-30	Very hard	7	3

5.2.2 Method

This study involved a comparison of Flesch Reading Ease scores for Hadley Hutt *PILLS* leaflets with patient information leaflets supplied with equivalent products from different drug manufacturers. Although similar methods[100] have been applied to the readability of patient education materials, no studies of the readability of pharmacy computer-produced materials have been reported in the literature.

Flesch Reading Ease scores were calculated manually by recording the average numbers of words per sentence and number of syllables from a sample of 100 words on each patient information leaflet. Average syllable numbers were recorded for five 100 word samples; and the average sentence length was calculated by dividing the total number of words in the leaflet by the number of sentences.

The accuracy of this simple method of calculating Flesch Reading Ease scores was checked by the use of two computer packages: Microsoft Word and Grammatik IV (Reference Software). Hadley Hutt Computing Ltd supplied a computer disk containing ASCII files of 10 *PILLS* leaflets. Flesch Reading Ease scores were

calculated by each package, as well as by the manual method described above. A comparison of the figures generated by each method is shown in Table 5.2. While there was some variation between the three sets of figures, the results were considered sufficiently consistent to proceed with the computerised methods of calculation. Similar results were obtained by Baker when comparing manual methods with computerised calculations performed by two software packages, RightWriter 3.0 and Grammatik III.[100]

Table 5.2: Comparisons of reading ease scores for *PILLS* leaflets using three different methods of calculation.

	Flesch reading ease scores		
Drug leaflet	*Manual*	*Microsoft Word*	*Grammatik IV*
Topical corticosteroids	68	61.7	62
Buccal nitrates	65	73.2	69
Migril	70	51.7	62
Vaginal nystatin	60	54.8	61
Nalidixic acid	70	73.0	74
Piroxicam	71	64.7	67
Calciferol	62	64.2	70
Naltrexone	65	64.9	67
Quinoderm	58	61.7	68
Vitamins A and D Capsules	68	66.9	67
Mean	65.7	63.7	66.7
Standard deviation	4.5	6.7	4.1

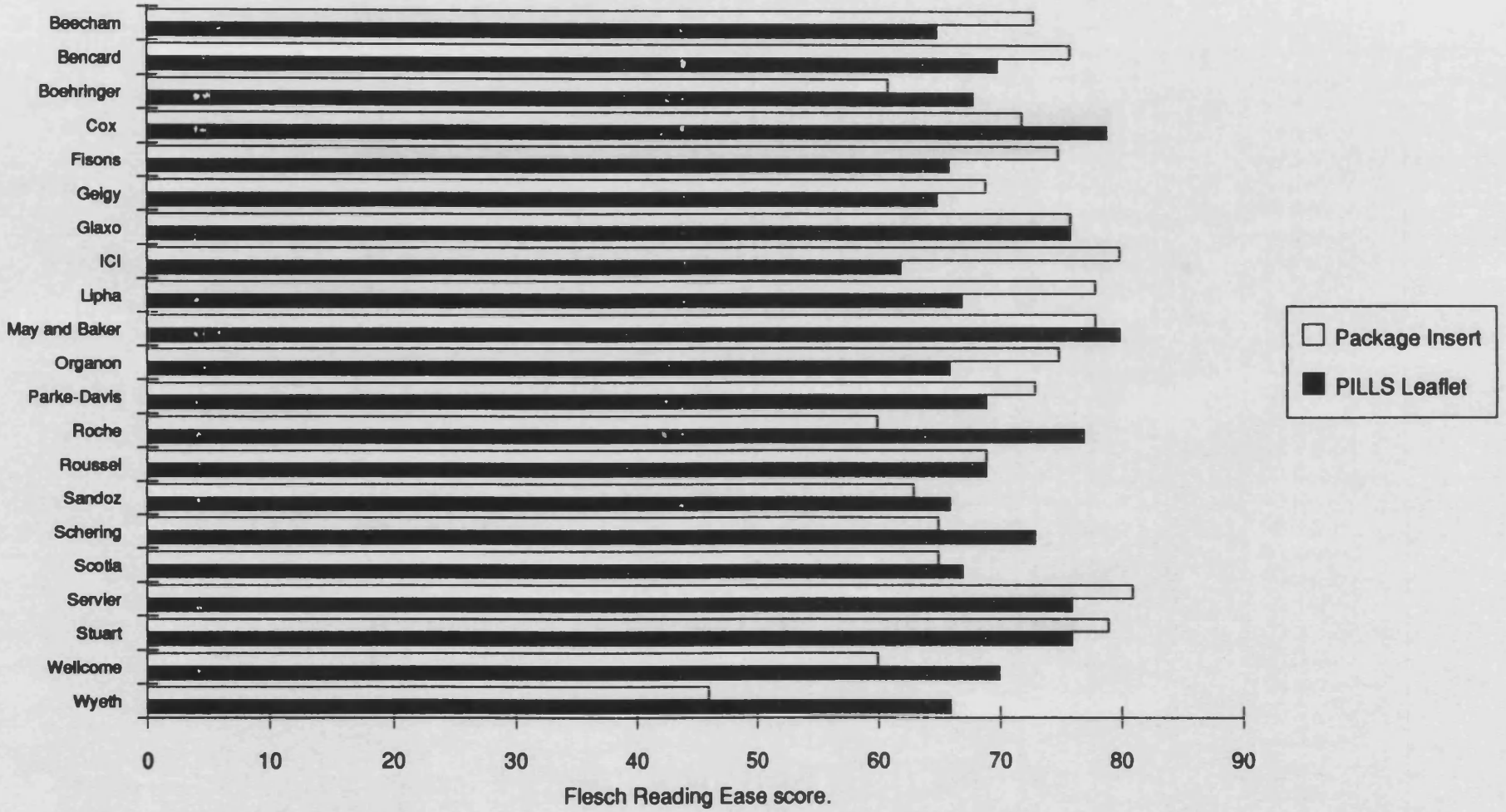
5.2.3 Results and Discussion

A comparison of manually calculated Flesch Reading Ease scores for 21 manufacturers' original pack leaflets and equivalent *PILLS* leaflets is shown in Figure 5.1.

Flesch Reading Ease scores for the original pack leaflets ranged from 46-81 (mean=70.2, std deviation=6.78). Figure 5.1 shows that all the original pack leaflets examined, except a package insert for Trinordiol produced by Wyeth, had a Flesch Reading Ease score of 60 or above. Using Table 5.1 to interpret these results shows that 90% of the adult population aged over 25, and 77% of the population aged over 75 would have been expected to understand such leaflets. However, only 31% of the population aged over 25, and 17% of the population aged over 75, would have understood the Trinordiol leaflet. The companies ICI and Servier produced leaflets with the highest scores of 80 or over. At this score, the leaflets should be understood by over 90% of the population aged over 75. These readability results reflect those from a recent study of industry-produced leaflets.[102]

The score of all *PILLS* leaflets was at least 60, ranging from 62-80 (mean=70.1, std. dev.=5.15). This implies that the leaflets produced by the *PILLS* system would be understood by 90% of the population over 25, and 77% of the population over 75. *PILLS* leaflets produced more consistent scores than original pack inserts, which is not surprising given that *PILLS* leaflets are derived from a single source, whereas the pack inserts come from different manufacturers.

Figure 5.1: Comparison of Flesch Reading Ease scores for PILLS leaflets and equivalent package inserts.



5.3 The Effect of Information Leaflets on Compliance

5.3.1 Introduction

As discussed in Section 5.1.1, there has been little published evidence to demonstrate that information leaflets actually improve patient compliance, though Raynor has described how a patient reminder chart has been shown to improve compliance.[103] These reminder charts were computer-generated automatically as part of the labelling process within a hospital pharmacy department. The charts gave information on the name(s) of patients' medication, doses and the times at which medication should be administered. However Raynor's charts did not provide information on therapeutic and side effects of prescribed medication.

There have been no published reports of the effects of pharmacy computer-produced patient information leaflets on compliance. It was decided, therefore, to conduct such a survey on a pilot scale examining the effect of *PILLS* leaflets on the compliance of patients receiving short courses of antibiotics for acute illness. It was felt that relatively large numbers of patients would be seen in community pharmacies over a period of six weeks in the winter months, thus facilitating data collection.

For the purpose of our study, patients were regarded as "compliant" if they completed their full course of antibiotics, and took the medication at an appropriate time in relation to food. Non-compliant patients were regarded as those who did not complete the prescribed course of antibiotics or took them at the wrong time in relation to food, for example taking oxytetracycline with meals.

5.3.2 Method

This study was undertaken with the assistance of Miss Karen Harris MRPharmS who designed the questionnaire and analysed the data as her final year undergraduate project.

Two community pharmacies operating the Hadley Hutt *PILLS* system were selected for this survey: a health-centre consortium pharmacy in Glastonbury, Somerset; and a suburban independent pharmacy in Plymouth, Devon. Both had participated in the earlier survey of *PILLS* users (Section 2.2.4), and the pharmacists in charge had indicated a willingness to participate in further research projects. A questionnaire was developed (Appendix 2, page 328), requesting the following information from patients: the name of their prescribed antibiotic; details of any side effects they experienced; when they took their medication in relation to meals; their age and sex; whether they received an information leaflet; and, if so, whether they had read and had felt they understood it.

Two hundred colour-coded questionnaires were sent to each pharmacy along with 200 Freepost envelopes. A covering letter was sent to each pharmacy requesting the co-operation of employed pharmacists. The instructions provided asked participating pharmacists to give a questionnaire to each patient over 16, who had a prescription dispensed for any antibiotic listed in Section 5.1 of the British National Formulary.[81] The Plymouth pharmacy was advised to hand out a green form and Freepost envelope to those receiving a *PILLS* leaflet and counselling with their antibiotic and an orange form with a Freepost envelope to those control patients receiving counselling only. The Glastonbury pharmacy followed the same principle using beige and purple forms. Pharmacy staff were instructed to continue the project for four weeks commencing 20 January 1992; data was collected for a further four weeks, ie. eight weeks from the beginning of the survey. Forms returned after that date were excluded from analysis.

Cross-tabulated responses from the completed questionnaires were examined using the SPSS/PC+ V4.0 statistics package, and the χ^2 test of independence.[63,64]

5.3.3 Results and Discussion

All 200 questionnaires were given to patients by the Plymouth pharmacy, and 197 questionnaires were given out by the Glastonbury pharmacy. A total of 167 completed questionnaires was received: 81 from Plymouth and 86 from Glastonbury. This represented an overall 42.1% response, which was slightly lower than anticipated. A disadvantage of the anonymous nature of this survey was that non-respondents could not be followed up. Of the 167 respondents, 85 (50.9%) had received a *PILLS* leaflet, and a further 28 (16.8%) had received a manufacturer's original pack insert. One or more suspected adverse drug reactions (ADRs) was suffered by 69 patients (41.3%)

The effect of the various examined parameters on patient compliance is shown in Table 5.3. Significant findings ($p<0.05$) are shown in bold type.

Table 5.3: Effects of patient information leaflet provision and ADRs upon compliance of male and female patients receiving antibiotic therapy.[2]

Patient group/category:	*Compliant:*	*Non-compliant:*
Receipt of any product information leaflet	106 (93.8%)	7 (6.2%)
Non-receipt of any product information leaflet	48 (88.9%)	6 (11.1%)
Receipt of *PILLS* leaflet	79 (92.9%)	6 (7.1%)
Non-receipt of *PILLS* leaflet	75 (91.5%)	7 (8.5%)
Male patients	62 (95.4%)	3 (4.6%)
Female patients	92 (90.2%)	10 (9.8%)
ADRs suffered by patient	**59 (85.5%)**	**10 (14.5%)**
No ADRs suffered by patient	**95 (96.9%)**	**3 (3.1%)**

[2]The figures quoted are numbers (and percentages) of patients in each category who complied or did not comply.

The only factor which was found to have any influence on patient compliance was the incidence of ADRs. Thus, patients who considered that they experienced one or more side effects at the time of taking their antibiotics were significantly (χ^2=7.4, df=1, p<0.01) more likely not to comply with their prescribed regimen. Further χ^2 tests were performed on cross-tabulated data to examine the possible associations of, first, leaflet provision and, second, the concurrent administration of other medication with the incidence of ADRs. Of the total 113 patients who received an information leaflet, 52 (46.0%) claimed to suffer an ADR whereas only 17 (31.5%) of the 54 patients who did not receive an information leaflet claimed to suffer an ADR. Of the 76 (45.5% of the total respondents) who were concurrently taking other medicines, 37 (48.7%) claimed to suffer side effects as a result of their antibiotic, compared with only 35 (38.5%) of the 91 (54.5% of all the respondents) who were not taking other medicines. Despite the apparent influence of patient information leaflets and other concurrent medication on the incidence of ADRs, these results were not significant at the 5% significance level.

The results from this limited study of patients receiving information leaflets provides some support for previously published work, although one cannot draw many conclusions from a survey with a less than 50% response. One has no way of knowing how the 57.9% of patients who did not respond behaved in taking their antibiotics. It is quite possible that those who did not respond (and who therefore did not comply with their questionnaire instructions) were less likely to comply with their prescribed regimen.

The results in Table 5.3 support previous work[89] showing that the provision of patient information leaflets does not improve patient compliance. Conversely, our results do not show that the provision of patient information leaflets has an adverse effect on patient compliance. The only factor that influenced patient compliance according to our survey was side effects produced by prescribed medication. This finding has

implications for prescribers, in that it is recommended, where practicable, they do not prescribe medication associated with a high incidence of side effects, for example the new macrolide clarithromycin should be regarded as preferable to the older drug erythromycin.

Gibbs *et al* presented conflicting evidence about whether issuing patients with information leaflets that provide detailed information about side effects causes them to report a higher incidence of ADRs.[88] While not statistically significant in our survey, the results might indicate that the use of patient leaflets does indeed increase the reporting of adverse effects. It is possible that detailing side effects to patients may cause them to attribute side effects to their medication, whereas the same symptoms might have been attributed to other causes if no such leaflet had been read by the patient. Further work is needed in this area, with a larger patient cohort to determine whether the provision of information on side effects does in fact cause patients to experience more adverse drug reactions. Such a survey should be carefully controlled, whenever possible, to exclude patients taking other medication.

5.4. Conclusions

1. Use of the Flesch Reading Ease formula, to calculate readability scores for both industry-produced and pharmacy-generated patient information leaflets, showed that most leaflets currently in use would be understood by a large majority of the adult population. However, one leaflet (Trinordiol) examined was unlikely to be understood by a majority of the population, due to the complex presentation of the information.

2. This limited study appears to show that patient information leaflets have a neutral effect on patient compliance.

3. These results show that patients who suspect that they have had ADRs as a result of prescribed antibiotic therapy are less likely to comply with their prescribed medication than those who had no suspected ADRs.

6. A Comparison of Patient Medication Record Systems Used by Community Pharmacists in the UK and USA

6.1 Introduction

During the course of the research described in this thesis, it became apparent that major differences existed between PMR systems in the nature of the information provided to pharmacists about potential drug interactions. This problem is discussed in detail in Chapter 8. Its was, therefore, considered essential to examine the sources of pharmaceutical information for those PMR systems that had the largest market share in the UK (Figure 2.3). Furthermore, it was considered to be advantageous to compare PMR systems used in the UK, with those in another English-speaking country with a tradition of PMR use in community pharmacy. The USA was selected for this purpose.

The purpose of this study was to compare and contrast pharmacy computer systems available in the UK and USA, with particular reference to those facilities that aid the community pharmacist in his clinical role. The sources of pharmaceutical information used to compile each system's database(s) have been noted, as well as the extent of referencing of the information that is provided to the pharmacist, for example on potential drug interactions. Other criteria discussed include: the ability of systems to report product information; how potential drug interactions are presented; whether information was provided on patient conditions; and the use of patient information leaflets. This survey was not intended to be a full evaluation of the functionality of the hardware and software of each PMR system.

6.2 Investigative Methods

6.2.1 Postal Survey (June 1992) of Suppliers of USA Pharmacy Computer Systems

An issue of the American pharmacy computing journal *ComputerTalk* was examined to obtain the names and addresses of 27 listed pharmacy computer system suppliers in the USA.[104] Each identified supplier was sent a postal questionnaire (Appendix 2, page 329) requesting information on: the type and supplier of the database(s) used within the system; drug use and dosage, adverse drug reactions; drug interactions, the recording of patient conditions and allergies; residential care and management information facilities.

Subsequent to the questionnaire survey, further details and demonstration software were requested from two suppliers of pharmacy databases in the USA: First Data Bank and Medi-span.

6.2.2 Examination of UK Systems

Each of the five systems identified as having the largest market shares in the UK in April 1991 (Figure 2.3) is available in the teaching laboratories of the School of Pharmacy and Pharmacology, University of Bath. The various factors examined in the survey of USA suppliers could therefore be investigated by use of the software in the laboratory.

A recent paper had discussed the inclusion of patient coding methods (Section1.5) used in a number of those computer systems used in general medical practice.[105] Enquiries were made as to which, if any, patient coding method was used in the AAH *Meditel*, VAMP, M-Tec and *Genisyst* systems used by GPs.

6.3 Results and Discussion

Of the 27 identified USA suppliers, only 13 (48.1%) responded by sending a completed questionnaire or information brochure. This was a slightly disappointing response, though perhaps not surprising given the location of the potential respondents, and their lack of a clear motive to reply. In the cases of non-response, the article in *ComputerTalk*[104] was scrutinised to extract relevant information from the published tables of data. Information obtained from the published tables, the returned questionnaires and suppliers' literature is shown in Tables 6.1-6.5.

The 27 identified USA suppliers are listed in Table 6.1, along with the type of database used (where this could be ascertained), the database supplier and whether a standard coding system was used for patient details. More suppliers employed a relational database structure than a flat-file structure, the former enables more flexible use of software, with the option of integrating third party databases, for example product information and features for processing insurance claims. The two principle data suppliers were found to be First Data Bank (Hearst Corporation) and Medi-span. The only patient coding system found in the USA systems was ICD-9 (International Classification of Diseases 9th edition). There is no standardised patient coding systems in use in UK pharmacy systems, though ICD-8 (International Classification of Diseases 8th edition) featured in the VAMP system used in UK general medical practice. The Read clinical coding system (Section 1.4) was implemented in the AAH *Meditel* and M-Tec systems; the suppliers of the *Genisyst* and VAMP systems indicated that they planned to include Read coding during 1993.

Table 6.2 shows comparisons between USA and UK systems in the provision of product information by the software. In general, more specific product information was provided by the USA systems, although the *Philex* database in the AAH *LINK* system provides "data sheet" style information on drug side-effects. The Hadley Hutt *PILLS* system provides information on the signs and symptoms of adverse effects by

means of information leaflets (Section 5.1.3). Information on normal dose ranges was provided by some of the USA and UK systems, including the AAH *LINK* and Hadley Hutt *PILLS* systems; the latter providing this data at the point of labelling.

Drug interaction monitoring was a feature of all the USA and UK systems examined (Table 6.3). The number of levels of severity of interaction ranged between one and five; with the USA systems tending to feature a higher number of levels. Drug interaction information was either provided by a data supplier, or developed in-house, or in consultation with a University School of Pharmacy. All of the USA systems provided literature references for drug interactions; whereas the Hadley Hutt *PILLS* system was the only UK system to do so. Reference sources used by pharmacy computer suppliers are described in detail in Section 8.1.

The recording of patients' clinical conditions has been discussed in Sections 2.3.3 and 4.1; the ability of systems to utilise this feature is shown in Table 6.4. Six systems (3PM McKesson, Etreby, RenLar Systems, Reynadyne Data Systems, Hadley Hutt *PILLS* and Park Systems) cross-referenced the databases for patient condition and for drugs, thus enabling automatic monitoring for contraindicated medication. All the USA suppliers who responded to the questionnaire stated that drug allergies could be recorded within their systems. With the exception of the Hadley Hutt *PILLS* system, the ability of UK systems to record patients' drug allergies was limited. Patient information leaflets, providing information on dispensed medicines, were available on all USA systems, and three UK systems. Two of the USA systems and one UK system provided patient leaflets on certain medical conditions, in addition to the information about dispensed products.

In the USA, software vendors sell products intended for pharmacists' use in residential care establishments, often in association with a portable computer which can be taken from the pharmacy into the residential care establishment.[104] Such computer systems

can be brought into the establishment by the pharmacist, who is then able to provide a clinical service, monitoring for drug interactions and contraindications. A similar system, *Littlefoot*, was launched in the UK in April 1993 by Surgichem Ltd. for use in conjunction with their *Nomad* monitored dosage system. At the time of this survey (June 1992), facilities for the management of monitored dosage dispensing, albeit dispensary-based, were included in the Hadley Hutt *PILLS* system, and were options available on the John Richardson and Park Systems' programs. All the systems examined also provided pharmacy management support, eg. stock control and prescription pricing.

6.3.1 Pharmacy Database Vendors in the USA

The information in Table 6.1 show that at least 17 out of the 27 USA computer suppliers used data from either First Data Bank or Medi-span. In the USA, the pharmacy systems were structured in a more modular manner than those in the UK. With the exception of the AAH *LINK* system, all drug file, pricing and interaction data in the UK were produced in-house, either with or without consultancy support. In the USA, pharmacy computer vendors sell programs that process database information that has been licensed by one or more third-party data-providers, eg First Data Bank and Medi-span.

6.3.1.1 First Data Bank

Both First Data Bank and Medi-span supplied product information and demonstration software. First Data Bank's *National Drug Data File* (NDDF) appeared to be more comprehensive than any comparable UK database. This system enabled dosage and frequency of administration to be checked, and issued a warning if they were unsuitable. Patient conditions and allergies could be recorded, and cross-referenced to the product database. References were provided for all information.. Interactions

were given five priority levels, which is one more than the nearest UK equivalent (Exeter Data Base Systems' *Interlex* [Section 8.1.6.2]).

A support system for clinical drug decision-making (R_X *Triage*) was included as part of First Data Bank's drug interaction monitoring software, providing information on how pharmacists should manage potential drug interactions when they are presented. An example is given in Figure 6.1.

Figure 6.1: Example of the drug interaction between anti-coagulants and salicylates as flagged by the R_X *Triage* system

Anti-coagulants + Salicylates

↓

Interaction: 1 - Most significant

↓

How is salicylate used?

Salicylate use:		***Action:***
1.	**Anti-platelet effect**	**Intentional interaction: monitor patient.**
2.	**Analgesia or anti-pyretic**	**Can acetaminophen (paracetamol) be used instead?**
3.	**Anti-inflammatory**	**Use non-salicylate instead.**

The demonstration software from First Data Bank enabled patient information leaflets to be examined. These were somewhat less detailed than those produced by the Hadley Hutt *PILLS* system (Section 5.1.3).

6.3.1.2 Medi-span

Medi-span's *Drug Therapy Screening System* (DTSS) has been rated better than R_X *Triage* in its ability to detect potential drug interactions.[165] As well as recording

product information, the DTSS system enabled the recording of patient's allergies and previous adverse reactions. The system could be utilised to predict other drugs to which a patient may also experience an adverse drug reaction. Patient, product and food databases were cross-referenced, and all interactions were referenced. This is in significant contrast to most systems used in community pharmacy in the UK. Five drug interaction warning levels were provided on this system, but the user had the opportunity to screen for, and only consider, the most serious level(s) if he so wished. A novel feature of this system was the derivation of the interaction warning level by a consideration of an interaction's predicted severity, likely frequency and documentation level (ie. the number of literature citations).

Patient education leaflets, to aid compliance with dispensed medicines, were produced by the DTSS system.

Table 6.1: USA pharmacy computer suppliers, the database type and supplier, and patient coding system employed (where this could be determined).

	Type	Supplier(s)	Coding system
3PM McKesson Corp.	Flat File	In-house	-
Bluff Creek Systems	-	Medi-span	-
BSI Business Systems Inc.	-	Medi-span	-
Cardinal Health Systems Inc.	Relational	First Data Bank, Medi-span	-
ComCoTec Inc.	-	-	-
Compute-Rx Inc.	Flat File	First Data Bank	-
Condor Corporation	Relational	First Data Bank	ICD-9
DAA Enterprises Inc.	-	-	-
Dagar Software Development Corp.	-	Medi-span	-
Delphi Associates, Inc.	-	-	-
Digital Simplistics Inc.	Flat File	First Data Bank	ICD-9
Etreby Computer Company, Inc.	Relational	In-house	ICD-9
Foundation Systems Inc.	-	Medi-span	-
General Computer Corporation	Flat File	First Data Bank, MONITORx	ICD-9
Health Business Systems Inc.	-	First Data Bank	-
Healthcare Computer Corporation	-	-	-
Interactive Systems & Management Corporation	-	First Data Bank	-
National Data Corporation	-	First Data Bank	-
pc I professional systems, Inc.	-	Medi-span	-
PharmaSoft Services	-	-	-
QS/1 Data Systems	-	-	-
RenLar Systems, Inc.	Relational	Medi-span	ICD-9
Response	-	Medi-span	-
Reynadyne Data Systems Inc.	Relational	First Data Bank	ICD-9
Synercom Computers, Inc.	-	-	-
Transaction Data Systems, Inc.	-	-	-
Zadall Relief (Drug Store Systems)	-	First Data Bank	-

Table 6.2: Information availability on dose and adverse drug reactions in USA and UK pharmacy systems.

	Dosing	ADRs	Severity	Incidence	Signs & Symptoms	Consideration of allergies, overdose and toxic effects
USA systems:						
3PM McKesson Corp.	YES	YES	YES	YES	YES	YES
Cardinal Health Systems Inc.	YES	YES	YES	YES	YES	NO
Compute-Rx Inc.	YES	YES	NO	NO	YES	NO
Condor Corporation	NO	YES	YES	NO	NO	YES
Digital Simplistics Inc.	NO	YES	YES	NO	YES	NO
Etreby	NO	NO	NO	NO	NO	NO
General Computer Corporation	NO	YES	NO	NO	NO	YES
RenLar Systems, Inc.	NO	YES	YES	NO	NO	YES
Reynadyne Data Systems Inc.	YES	NO	NO	NO	NO	NO
UK systems:						
AAH *LINK*	YES	YES	YES	NO	NO	NO
Chemtec *Alchemist 3000*	NO	NO	NO	NO	NO	NO
Hadley Hutt *PILLS*	YES	leaflets	leaflets	NO	leaflets	NO
John Richardson Computers	NO	NO	NO	NO	NO	NO
Park Systems	NO	NO	NO	NO	NO	NO

Table 6.3: The provision of drug-interaction information by USA and UK pharmacy systems: number of interaction levels, background information, database and references used.

	Drug interactions	*No. of severity levels*	*Provider of drug interaction data*	*References cited*	*Reference source(s) used*
US systems:					
3PM McKesson Corp.	YES	5	Univ. Michigan	YES	Facts & Comparisons[106]
Bluff Creek Systems	YES	?	Medi-span	YES	Hansten[107]. Facts & Comparisons
Cardinal Health Systems Inc.	YES	3	First Data Bank & Medi-span	YES	Hansten, USP DI[108]
Compute-Rx Inc.	YES	3	First Data Bank	YES	Hansten
Condor Corporation	YES	5	First Data Bank	YES	Hansten. Facts & Comparisons
Digital Simplistics Inc.	YES	3	Medi-span	YES	Hansten. Facts & Comparisons
Etreby	YES	5	In-house	YES	Hansten. Facts & Comparisons
General Computer Corporation	YES	3	MONITORx	YES	
QS/1 Data Systems	YES	?		YES	Hansten, USP DI, EDI[109]
RenLar Systems, Inc.	YES	5	Medi-span	YES	Hansten
Reynadyne Data Systems Inc.	YES	3	First Data Bank	YES	Hansten
Transaction Data Systems, Inc.	YES	?	First Data Bank		
Zadall Relief (Drug Store Systems)	YES	?			
UK systems:					
AAH *LINK*	YES	4	Exeter Data Base Systems	NO	
Chemtec *Alchemist 3000*	YES	3	In-house	NO	
Hadley Hutt *PILLS*	YES	2	In-house	YES	BNF[81], Stockley[59], USP DI
John Richardson Computers	YES	1	In-house / Stockley	NO	
Park Systems	YES	3	Liverpool School of Pharmacy	NO	

Table 6.4: The recording in pharmacy computer systems, of patient conditions, allergies, effects on clinical tests (eg. urine analysis) and cross-referencing between patient and drug databases; the production of information leaflets on dispensed products and a patient's conditions.

	Patient Information:				*Leaflets:*	
	Conditions	Drug Cross-Reference	Allergies	Clinical Tests	Medicines	Conditions
USA systems:						
3PM McKesson Corp.	YES	YES	YES	YES	YES	NO
Cardinal Health Systems Inc.	unknown	unknown	unknown	unknown	YES	YES
Compute-Rx Inc.	YES	NO	YES	YES	YES	NO
Condor Corporation	YES	NO	YES	NO	YES	NO
Digital Simplistics Inc.	YES	NO	YES	NO	YES	NO
Etreby	YES	YES	YES	YES	YES	NO
General Computer Corporation	YES	NO	YES	YES	YES	NO
RenLar Systems, Inc.	YES	YES	YES	YES	YES	NO
Reynadyne Data Systems Inc.	YES	YES	YES	NO	YES	YES
Zadall Relief (Drug Store Systems)	unknown	unknown	unknown	unknown	YES	NO
UK systems:						
AAH *LINK*	YES	NO	NO	NO	NO	NO
Chemtec *Alchemist 3000*	v. limited	NO	limited	NO	NO	NO
Hadley Hutt *PILLS*	YES	YES	YES	NO	YES	YES
John Richardson	NO	NA	penicillin only	NO	YES	NO
Park Systems	YES	YES	limited	NO	YES	NO

Table 6.5: Residential care facilities and management information provided by USA and UK suppliers of pharmacy computer systems.

	Residential Care		*Management Information*		
	Regimen Review	Utilization Review	Stock Control	Usage Enquiry	Pricing
USA systems:					
3PM McKesson Corp.	YES	YES	YES	YES	YES
Cardinal Health Systems Inc.	NO	NO	YES	YES	YES
Compute-Rx Inc.	YES	YES	YES	YES	YES
Condor Corporation	YES	YES	YES	YES	YES
Dagar Software Development Corporation	YES	YES	unknown	unknown	unknown
Digital Simplistics Inc.	YES	YES	YES	YES	YES
Etreby	YES	YES	YES	YES	YES
General Computer Corporation	NO	YES	YES	YES	YES
National Data Corporation	YES	YES	unknown	unknown	unknown
RenLar Systems, Inc.	YES	YES	YES	YES	YES
Reynadyne Data Systems Inc.	NO	NO	YES	YES	YES
UK systems:					
AAH *LINK*	NO	NO	YES	NO	YES
Chemtec *Alchemist 3000*	NO	NO	YES	NO	YES
Hadley Hutt *PILLS*	YES	YES	YES	YES	YES
John Richardson	Option	Option	YES	NO	YES
Park Systems	Option	Option	YES	YES	YES

6.3.2 Drug-Food Interactions

Some of the USA systems featured drug-food interaction software. This tends not to feature on UK systems, except within the patient advice printed on information leaflets. However, all of the UK systems that were examined produced BNF additional labels[81] detailing whether products should be taken with food or on an empty stomach.

6.3.3 Third Party Links

Each of the UK systems examined permitted the use of a modem link to pharmaceutical wholesalers for the purposes of stock ordering. Most of the USA pharmacy computer systems also possessed a facility to pass details about supplied products to insurance companies funding drug costs; this contrasts with the UK where direct links between community pharmacies and the Prescription Pricing Authority have not yet evolved.

6.4 Conclusions

1 This survey has shown that the key patient-oriented functions of pharmacy computer systems, enabling prescription labelling, updating of medication records and drug interaction monitoring are broadly similar in the UK and USA.

2. The principal variation between UK and USA systems lies in the provision of clinical data. Most UK systems use data that had been gathered by the supplier; whereas in the USA, pharmacy computer system suppliers use data which has been compiled by companies specialising in clinical data provision.

7 The Clinical Application of Patient Medication Records and the Assessment of Benefits to Patients

7.1 Introduction

The original aim of our research into the use of patient medication records (PMRs) was to assess the clinical impact of PMRs on community pharmacy practice. One of the principal objectives was to test a hypothesis that the use of PMRs held in community pharmacies provides an improvement in patient care, through interpretation of PMR data by the pharmacist who subsequently advises the patient and/or the prescriber. During the study reported in this Chapter, cases are considered where the use of PMR systems potentially enhanced patient care and altered treatment outcome.

The modern role of the community pharmacist has two core activities; these are the supply of prescription and non-prescription medicines, and the associated provision of information and advice to patients and prescribers with, or without, the supply of a product. The provision of advice encompasses cases where the pharmacist offers a response to patients' symptoms. Before supplying a medicinal product to a patient, a pharmacist has a professional duty of care to ensure that the product is both safe and appropriate for use as determined by therapeutic knowledge and legislation at any given time.

One use of PMRs is to ensure that patients do not receive medication when it is contraindicated or inappropriate[7]; for example, a non cardio-selective beta-blocker may induce bronchospasm in an asthmatic patient.[56] Similarly, it may be inappropriate to supply certain non-prescription medicines to patients suffering from certain medical conditions; for example, sympathomimetic decongestants may be hazardous in patients with cardiovascular disease.[81]

Drug interactions, ranging in significance from some merely of pharmacological interest to others that are life-threatening, may occur with medicines that are prescribed or those purchased without a prescription. It is a routine, but essential, role of the pharmacist to monitor for the situation when two interacting medicines are prescribed on a single prescription. A logical extension to this is where a pharmacist, through the maintenance of prescription records, is able to monitor for interactions between newly-prescribed medicines and those which were dispensed previously. Computerised PMR systems can automatically examine records for potential interactions faster than a community pharmacist using manual records and reference books. We have shown that this is a prime reason for pharmacists having purchased computerised PMR systems (Chapter 3).[79] Pharmacists can also use PMRs to check the appropriateness of patient-requested or counter-prescribed medicines, where the potential for important drug interactions is considerable; for example, ibuprofen can raise the plasma level of lithium to a level at which toxic side effects may occur.[59]

Prescription forms presented in a pharmacy may contain clinical errors and omissions, other than those referred to above. The wrong drug may be prescribed, or the wrong strength, dose, or patient's name may be stated on the prescription form. Such errors are likely to arise as a result of administrative errors within the surgery. Prescriptions may be written so that they do not comply with the requirements of the Medicines Act 1968 and the Misuse of Drugs Act 1971. Such errors, although reported by respondents, were not considered within the scope of this study and were therefore excluded from the results.

Under Regulations made in 1979, pharmacists have been able, in an emergency, to supply prescription-only medicines without a prescription form.[110] To do this, certain requirements must be fulfilled in order to comply with the requirements of the Medicines Act 1968. The use of PMRs normally would facilitate the administration of

emergency supplies, by providing a record of previous dispensing of the product(s) requested by patients or prescribers.

Strand *et al* have discussed the need for hospital-based clinical pharmacists to document their activities.[111] A number of papers have been published describing such documentation of clinical interventions made by hospital pharmacists. One study, based on the use of a system for coding intervention data used a mainframe computer was used to store and process alpha-numeric codes representing clinical pharmacists' interventions.[1U2] Catania *et al* have discussed the cost-savings generated by the activities of clinical pharmacists in a 324-bed non-profit community hospital in California.[113] They were able to demonstrate average net cost savings of $3739 per month, over a four-year period from 1986-90. Brown has published a paper discussing the clinical merit of hospital clinical pharmacists intervening to initiate or discontinue drug therapy.[114] It was shown that 27 out of 106 clinical interventions made by the pharmacists concerned, during the experimental period, were judged to have been of "very significant benefit" or "significant benefit" to patients. In comparison, only two cases were judged to have been detrimental to patients. Problems associated with documenting clinical pharmacy interventions in the hospital setting have been described, emphasising the need to record those interventions with the greatest clinical significance.[115] A description of a computerised system to record hospital pharmacists' clinical interventions has been described by Schumock *et al.*[116]

Hospitalisation as a result of the consequences of drug interaction has been described.[117] In the United States, Rupp has published work evaluating the community pharmacist's role in correcting prescribing errors.[118-122] One paper[118] described the nature of prescription errors encountered by the community pharmacist. These included errors of omission (51%), such as incomplete prescription details, and errors of commission (29%), such as incorrect drug strength. Remaining errors included drug allergies and drug interactions. In his subsequent paper[119], he

estimated the monetary values of intervening to deal with such problematic prescriptions. The average cost per prescription of the pharmacist's time in conducting the intervention was estimated to be $1.75, whereas the value of the pharmacist's intervention, as determined by the avoidance of medical care (visits to a physician) was estimated to be $7.15. A further paper[120] described the results of a project where community pharmacists in the United States and Canada were encouraged to spontaneously document and report any reactive interactions made by pharmacists. In that paper prescribers' errors of commission were found to be the most frequently reported problems. The two drug groups most frequently associated with these reactive interventions were anti-infective agents (22.6%) and hormones (8%). Rupp described the purpose of the traditional collaboration between physician and pharmacist in the delivery of care as being "to combine the unique knowledge and competencies of each to achieve optimal outcomes in, and for, the patient."[121] A central responsibility of the pharmacist in this role is to screen new prescription orders to ensure that the prescribed therapy is safe and appropriate. In a later paper[122] he proposed a value of $122.98 per "problematic prescription", as being the cost of avoidance of medical care, had the pharmacist not intervened. This value equated to $2.32 per each new prescription order. The considerably higher figure produced in this paper, was higher than that in his earlier paper[119] due to the consideration of the high cost of hospitalisation that would have been required had some of the pharmacist interventions not been made.

There have been no published reports to-date of similar studies in the UK, although Maguire and Lowrie have described the nature of some prescribing errors encountered in practice.[123] Neville *et al* have developed a system for classifying prescription errors in general practice; in so doing emphasising the key role that community pharmacists could play in influencing prescribing practice.[124] Vitillo and Lesar have described ways in which prescribing errors can arise.[125] Examples of "assumption" errors included co-prescribing of drugs which interact, and writing a prescription on

the wrong patient's chart. Documented "selection" errors included the prescribing of inappropriate antibiotics, or the mis-selection of products by name, eg. *Zostrix cream* instead of *Zovirax cream*. Lastly, "capture" errors included the prescribing of incorrect dosage regimens. It is possible that audit of the community pharmacist's clinical work, through routine documentation of clinical interventions might prove beneficial both for litigation-defence and for justifying increased professional remuneration. Payne *et al* have described the use of a PMR system in one community pharmacy to identify missing details on repeat prescriptions.[126]

In the following study we have examined records made by community pharmacists when they have made interventions in practice. Despite the necessity for pharmacists to maintain various statutory records, it is not normal practice in the United Kingdom for them to document of prescribing errors and interventions. During this study (Autumn 1991- Spring 1993) the *PILLS* system was the only computerised system available in the UK that provided a facility to record any type of pharmacist intervention. The *PILLS* system requires the operator to record, in the database, their actions when faced with a probable drug interaction or recognised contraindication. For example, the operator could enter that the prescriber confirmed that the co-administration of two interacting drugs was intended; or, in other circumstances, that a patient no longer suffers from a particular clinical condition. The *Alchemist 3000* system (Chemtec Systems Ltd.) requires the user to enter a password when presented with a potential drug interaction flagged at the highest level of significance.

7.2 Method

7.2.1 Equipment and Materials Used

All documentation was produced using Microsoft Word for Windows on a Viglen Genie PC, and a Hewlett-Packard DeskJet printer. Microsoft Excel and SPSS-PC+ were used for storing and analysing data. Completed record forms were returned under a Freepost arrangement with the Post Office.

7.2.3 Selection of Pharmacies

The starting point for this study was the distribution of the postal questionnaire (Appendix 2, page 311) sent to 1000 community pharmacies in England and Wales, selected at random from the Register of Premises of the Royal Pharmaceutical Society of Great Britain. That questionnaire (described in Chapter 2) not only presented a series of questions requesting comprehensive information about the uses of PMR systems, but also concluded with an invitation to the respondent to take part in a further long term research programme. Respondents could either respond with a yes or no response, or request further information. All respondents who did not respond negatively were sent an information letter giving details of the nature of data to be recorded, and a response slip to be returned if they wished to proceed with the continuing programme.

All pharmacists who, at that stage, still wished to continue were sent a package containing several blank forms for recording clinical intervention events. Freepost envelopes, instructions on how to complete the record forms and a sheet containing sample entries.

7.2.4 Design of the Clinical Intervention Event Record Form

The purpose of the clinical intervention event record form was to provide a simple, rapid method for community pharmacists to log their intervention activity. A copy of

the record sheet is shown in Appendix 2, page 331. Each record sheet provided a space for the four digit identity code used in the initial survey questionnaire to identify the pharmacy concerned, thereby ensuring anonymity of the collected data. The record sheet provided six columns in which pharmacists entered data as illustrated in Figure 7.1.

Figure 7.1: Data entry columns in the clinical intervention record sheet.

DATE	INTERVENTION CATEGORY	DRUG(S) INVOLVED	PATIENT GROUP	PMR USE Y / N	NOTES/ ACTION

In the first column pharmacists recorded the date the intervention was made. A code for the type of intervention was entered in the second column. Codes were provided as shown in Table 1, to minimise the amount of writing when completing the form.

Table 7.1: Clinical intervention event category codes.

C1	Contraindicated prescribed drug
C2	Contraindicated OTC drug
E	Emergency supply of prescription-only medicine
I1	Drug interaction between two drugs on presented prescription
I2	Drug interaction with a drug previously dispensed
I3	Drug interaction with OTC medicine
M1	Prescription error-incorrect drug on presented prescription
M2	Prescription error-incorrect strength on presented prescription
M3	Prescription error-incorrect dose on presented prescription
M4	Prescription errors incomplete/incorrect patient details eg. Mr Jones' Tablets on Mrs Jones' prescription.

The third column enabled pharmacists to enter the drug(s) associated with the intervention event. The patient group, if known, was noted in the fourth column, using single letter abbreviation as shown in Table 7.2.

Table 7.2: Patient at-risk groups and associated codes.

A	Asthmatic
B	Breast-feeding
C	Cardio-vascular disease inc. cardiac failure, hypertension, clotting disorders
D	Diabetic
E	Expectant mothers, pregnant
F	Fits, epileptic
G	Geriatric, elderly patients
H	Hepatic impairment
I	Immuno-suppressed
M	Mentally ill, psychiatric
O	Ophthalmic disorders, eg. glaucoma
P	Parkinson's disease
R	Renal impairment
S	Skin diseases
T	Thyroid patients
U	Peptic Ulcer
Y	Young patient (paediatric, under 12)
N	Not listed above, miscellaneous.

The fifth column was used to show whether a PMR system was used during the intervention and the sixth column provided a space for explanatory notes.

7.2.5 Pilot Study

Before general distribution to the participating pharmacists, the use of the record sheet was tested, for a six week period, in the geographically-closest community pharmacy taking part in the programme. No problems were encountered and it was decided to proceed with data collection.

7.2.6 Phase I Study: Data Collection and Processing

Record sheets were returned by each participating pharmacy every six weeks, over the 18-month period September 1991-February 1993. A postal reminder was sent when a pharmacy did not return a sheet within two weeks of the due-by date. The data from each record sheet were entered in a database created using Microsoft Excel. The following were recorded in the database for each event: a code representing the relevant pharmacy, the intervention category, the drug(s) involved and their British National Formulary (BNF) code, the patient group, whether a PMR was used, and any explanatory notes required.

The database was constructed to facilitate data manipulation, including ordered sorting by any of the columns on the record sheet. The database permitted the recording of up to three drugs associated with each clinical intervention event. Any product associated with an event was recorded using its generic name, except proprietary combination products with no generic equivalent, for example, *Kalten*. The data were transferred to the statistics program SPSS-PC+ for statistical analysis.

7.2.7 Phase II Study: Survey in Branches of a Multiple Pharmacy Company

One purpose of the study described above (Section 7.2.6) was to determine whether it could be shown that pharmacists' use of PMRs improved patient care. The aim was to analyse results from a group of pharmacies in the original sample that used PMRs, in parallel with a control group which were using simple labelling systems only. During the initial stages of the project a problem was encountered in the selection of pharmacies taking part in the programme: substantially fewer pharmacies without PMRs wished to take part than those using PMRs. Therefore an additional survey was undertaken in parallel in 30 branches of a multiple pharmacy company: 15 branches using a PMR system were requested to record clinical intervention events for three six-week periods, alongside 15 branches using a simple labelling system as a control

group. Each group contained pharmacies matched in size, location and the number of prescription items dispensed.

For the purposes of both the Phase I and Phase II studies, "computerised PMR-users" were considered as those pharmacies in which patient medication records were stored on a computer. "Non-computerised PMR-users" were considered as those pharmacies in which manual patient records were maintained, or where no patient records were stored.

7.3 Results

7.3.1.1 Pharmacies Participating in Phase I Survey

Results from the original survey (April 1991) showed that 253 respondents were interested in taking part in a further research programme. Of these, 42 eventually agreed to participate. During the early stages of data collection, the number of pharmacies continuing to provide fell to 28. Characteristics of these pharmacies, and the pharmacists in charge, are given in Tables 7.3-7.5, using the categories previously defined in our original questionnaire (Appendix 2, page 311).

Table 7.3: Ownership of the pharmacies participating in the survey.

Independent	9
Small multiple (2-10 pharmacies)	7
Large multiple (11 or more pharmacies)	12

Table 4. Year of registration of the pharmacist in charge of the pharmacy.

1986-1990	16
1981-1985	5
1976-1980	3
1971-1975	1
1966-1970	-
1961-1965	2
1956-1960	1

Table 7.5: Use of patient medication record system in pharmacies in the survey.

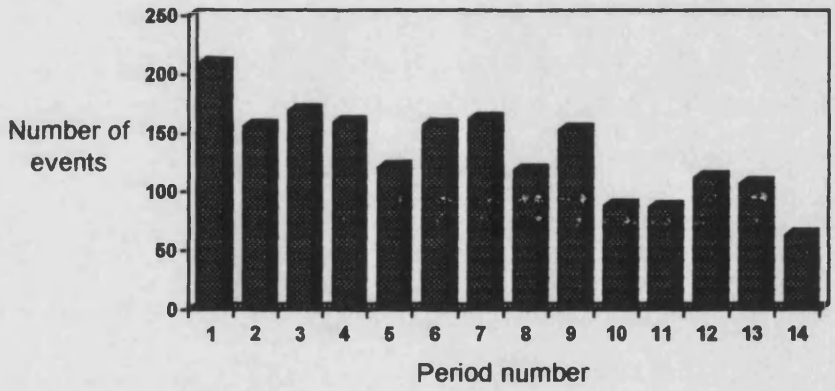
Manual system	3
Computer	19
No system used	6

System in use at the outset of the survey were John Richardson, Park systems, AAH Link and Mawdsley-Brooks and in-house systems, used by large multiple companies. One non-PMR user purchased a Chemtec system during the study. All the PMR systems were installed between 1987 and 1991, and 16 systems had been installed since 1989.

7.3.1.2 Clinical Intervention Events

By the end of the survey in February 1993, a total of 1862 clinical intervention events had been recorded and entered into the Excel database. The number of interventions reported per pharmacy ranged between one and 473. Thirteen pharmacies ceased to provide regular data reports the last eight months of the survey, hence a low number of reported events from some contributors. At no stage during the experimental period did, the proportion of prescriptions associated with a *documented* clinical intervention event exceed 2% of the total number of dispensed prescription items. Figure 7.2 shows the number of events reported during each six week period.

Figure 7.2: Number of clinical intervention events during each six week data collection period.



Of the 1862 recorded events, 1457 (78.2%) took place in pharmacies using a computerised PMR system, 111 (6%) in pharmacies using a manual system, and 294 (15.8%) in those pharmacies not maintaining PMRs. Due to the number of pharmacies in this survey, and the variety of computer systems used, it was not possible to detect significant differences between each system. A patient medication record was used in 1234 (66.3%) of the interventions. The use of PMR systems in association with clinical intervention events is shown in Table 7.6. The number of intervention events

in each pre-defined category of event is given in Table 7.7. Table 7.8 shows the frequency of patient at-risk groups occurring within the data.

Table 7.6: The use of PMR systems in association with clinical intervention events (percentages of totals in brackets).

		PMR type:			
		Computer	Manual	None	Total
PMR Used:	Yes	1168 (80.2)	66 (59.5)	0	1234 (66.3)
	No	289 (19.8)	45 (40.5)	294 (100)	628 (33.7)
	Total	1457 (100)	111 (100)	294 (100)	1862 (100)

Table 7.7: Number of clinical intervention events within each category of event, related to whether a PMR system was used (percentages of totals in brackets).

Intervention category	*PMR used*	*PMR not used*	*All events*
Prescription error-incorrect strength	263 (21.3)	103 (16.4)	366 (19.7)
Prescription error-incorrect dose	186 (15.1)	96 (15.3)	282 (15.7)
Interaction between a previously dispensed medicine and a newly-prescribed medicine	259 (21.0)	19 (3.0)	278 (14.9)
Prescription error-incorrect drug	162 (13.1)	110 (17.5)	272 (14.6)
Interaction between two drugs on a presented prescription	100 (8.1)	97 (15.4)	197 (10.6)
Contraindicated prescription medicine	98 (7.9)	47 (7.5)	145 (7.8)
Prescription errors incomplete/incorrect patient details	44 (3.6)	66 (10.5)	110 (5.9)
Emergency supply	68 (5.8)	38 (6.1)	106 (5.7)
Contraindicated non-prescription medicine	24 (1.9)	42 (6.7)	66 (3.6)
Interaction with a non-prescription medicine	28 (2.3)	7 (1.1)	35 (1.9)
Miscellaneous, not listed above	2 (0.2)	3 (0.5)	5 (0.3)
Total	1234 (100)	628 (100)	1862 (100)

Table 7.8: Frequency with which patient at-risk groups occur within clinical intervention event data (percentages of totals in brackets).

	PMR used	*PMR not used*	*All events*
Geriatric	411 (33.3)	101 (16.0)	512 (27.5)
Cardio-vascular disease	231 (18.7)	72 (11.5)	303 (16.3)
Asthmatic	129 (10.5)	65 (10.4)	194 (10.4)
Young patient	31 (2.5)	94 (15.0)	125 (6.7)
Diabetic	55 (4.5)	16 (2.6)	71 (3.8)
Mentally ill	39 (3.2)	20 (3.2)	59 (3.2)
Expectant mother	15 (1.5)	30 (4.9)	45 (2.4)
Fits, epileptic	29 (2.4)	5 (0.8)	34 (1.8)
Parkinson's disease	19 (1.5)	3 (0.5)	22 (1.2)
Peptic ulcer	13 (1.1)	5 (0.8)	18 (1.0)
Skin diseases	7 (0.6)	11 (1.8)	18 (1.0)
Thyroid disorders	11 (0.9)	4 (0.6)	15 (0.8)
Ophthalmic disorders	9 (0.7)	6 (1.1)	15 (0.8)
Breast-feeding	2 (0.2)	3 (0.5)	5 (0.3)
Renal impairment	4 (0.3)	1 (0.2)	5 (0.3)
Immuno-suppressed	2 (0.2)	1 (0.2)	3 (0.2)
Hepatic impairment + immuno-suppressed	1 (0.1)	-	1 (0.1)
Not listed, miscellaneous	226 (18.3)	191 (30.5)	417 (22.4)
Total	1234 (100)	628 (100)	1862 (100)

Applying the χ^2 test of independence[63] to the results in Table 7.8 showed that the use of a PMR system was less likely to result in patients being classified as miscellaneous ($p<0.0001$).

Table 7.9: BNF classifications and Department of Health prescription data, for products associated with clinical intervention events in this study.

BNF classification	Occasions when a product within BNF category has been associated with a clinical intervention event	% of total number of products(*a*)	% 1990 total NHS prescriptions (*b*)	Factor *a*/*b*
Gastro-intestinal system	102	3.98	7.96	0.50
Cardio-vascular system	657	25.63	17.23	1.49
Respiratory system	319	12.45	8.80	1.41
Central nervous system	450	17.56	19.78	0.89
Infections	347	13.54	12.13	1.12
Endocrine system	132	5.15	4.35	1.18
Obstetrics, gynaecology & urinary-tract	211	8.23	2.63	3.13
Malignant disease and immunosuppression	12	0.47	0.30	1.56
Nutrition and blood	52	2.03	3.50	0.58
Musculoskeletal and joint diseases	155	6.05	5.40	1.12
Eye	31	1.21	2.56	0.47
Ear, nose and oropharynx	23	0.90	1.22	0.74
Skin	53	2.07	9.58	0.22
Immunological products and vaccines	8	0.31	0.32	0.98
Unclassified	11	0.43	0.81	0.53
Totals	2563	100.00	96.57	

Of the 1862 documented clinical intervention events, 17 (0.9%) were associated with groups of three products, 683 (36.7%) were associated with a combination of two products and 1162 (62.4%) were associated with individual products. A total of 2563 products were associated with the 1862 events. The BNF classifications of the 2563 products involved in these 1862 clinical intervention events are shown in Table 7.9. In 11 cases the BNF classification could not be applied to the product, for example, homoeopathic preparations.

Table 7.9 shows the number of products in each BNF classification, together with the percentage of the total 2563 products that each BNF group represented. These percentages are then compared with data supplied by the Department of Health (personal communication) which have been interpreted to give total prescription numbers for products in each BNF category for 1990. The Department of Health have not used the BNF classification to date, but instead have used a similar system of prescribing by therapeutic class. These figures do not add up to 100% since some listed products are not in the BNF, for example X-ray contrast media.

Comparing the frequency with which products were associated with intervention events, with prescription data from the Department of Health enabled us to standardise our findings. A factor, *a/b*, was calculated to illustrate those pharmacological groups of drugs which were particularly prone to intervention event association. If this calculated factor *a/b* equalled one, the frequency of reported interventions with a particular group of drugs would be exactly in proportion to the number of times such drugs were prescribed. If *a/b* was greater than one, the number of reported interventions associated with that category of drugs was higher than one might expect. Pharmacological groups with a high *a/b* factor were those used in obstetrics, gynaecology and acting on the urinary-tract. Drugs acting on the skin had a low *a/b* factor.

Those drugs most often associated with the reported clinical events are listed in Table 7.10.

Table 7.10: Drugs most frequently associated with clinical intervention events.

	Number of events	% occurrence		Number of events	% occurrence
Amoxycillin	87	4.67	Propranolol	30	1.61
Atenolol	82	4.40	Theophylline	28	1.50
Salbutamol	75	4.03	Aspirin	26	1.40
Logynon	62	3.33	Captopril	25	1.34
Digoxin	49	2.63	Temazepam	25	1.34
Beclomethasone	46	2.47	Diltiazem	24	1.29
Nifedipine	46	2.47	Phenytoin	23	1.24
Erythromycin	44	2.36	Indomethacin	22	1.18
Penicillin V	44	2.31	Prednisolone	22	1.18
Microgynon 30	40	2.15	Ciprofloxacin	21	1.13
Co-proxamol	39	2.09	Frusemide	21	1.13
Enalapril	37	1.99	Isosorbide mononitrate	20	1.07
Co-amilofruse	35	1.88	Paracetamol	20	1.07
Ibuprofen	35	1.88	Co-amilozide	19	1.02
Warfarin	35	1.88	Cimetidine	19	1.02
Pseudoephedrine	34	1.83	Verapamil	19	1.02
Diclofenac	32	1.72			

A cross-tabulation of the clinical intervention event categories (Table 7.1) and the patient at-risk groups (Table 7.2) with which they were associated is shown in Table 7.11. Points of particular note in Table 7.11 are: the association of asthmatic patients with contraindicated prescribed products (C1) and emergency supplies (E); the association of patients with cardio-vascular conditions (C) with contraindicated non-prescription products (C2) and drug interactions (I1-3); the association of diabetic patients with contraindicated prescribed products (C1); and a high number of drug interactions (I1-3) potentially affecting elderly patients (G). The high incidence of

incorrect strength (M2) and incorrect dose (M3) interventions with both geriatric (G) and young patients (Y) is of note.

Table 7.11: Cross-tabulation of at-risk patient groups and clinical intervention categories. Figures of particular note in bold type.

Patient at risk group	*Contra-indicated prescription medicine*	*Contra-indicated non-prescription drug*	*Emergency supply*	*Interaction: two drugs on presented prescription*	*Interaction with previously dispensed medicine*	*Interaction with non-prescription medicine*	*Incorrect drug*	*Incorrect strength*	*Incorrect dose*	*Incorrect patient*	*Miscellaneous*	Total
Asthmatic	**44**	7	**29**	7	18	2	27	47	6	6	1	194
Breast-feeding	2	1	-	-	2	-	-	-	-	-	-	5
Cardio-vascular disease	16	**17**	29	**52**	**29**	**13**	30	68	33	16	-	303
Diabetic	**23**	2	4	2	2	-	23	3	10	2	-	71
Expectant	10	10	1	3	-	-	5	6	8	2	-	45
Fits, epileptic	2	-	7	5	7	1	4	5	3	-	-	34
Geriatric	8	6	17	**53**	**65**	**13**	89	**120**	**109**	30	2	330
Hepatic-impairment	-	-	-	-	1	-	-	-	-	-	-	1
Immuno-suppressed	-	-	1	-	-	-	-	1	1	-	-	3
Mentally ill	-	-	1	13	7	-	9	15	9	4	1	59
Ophthalmic disorders	1	5	-	-	-	-	2	6	-	1	-	15
Parkinson's disease	-	-	-	1	2	-	2	3	12	2	-	22
Renal impairment	-	1	-	-	-	1	1	2	-	-	-	5
Skin diseases	1	1	1	1			7	2	3	2	-	19
Thyroid patient	1	-	1	-	-	-	-	11	2	-	-	15
Peptic Ulcer	11	4	1	-	-	1	1	-	-	-	-	18
Young patient	16	7	2	3	-	-	16	**28**	**38**	14	1	125
Not listed, miscellaneous	10	5	12	57	145	4	56	49	48	31	-	417
Total	145	66	106	197	278	35	272	366	282	110	5	1862

7.3.2 Phase II Study: Multiple Pharmacy Company Survey Results

Of the 15 pharmacies selected as a control group of non-users of PMR systems, one of those which responded was found to be maintaining manual records. This pharmacy only documented two clinical intervention events, and therefore, did not bias the results to any significant extent.

Over the 18 week period of study, completed clinical intervention record sheets were received from 16 pharmacies operating a PMR system (7 computerised PMR-users and 9 non-computerised PMR-users), representing 50% of the total selected sample. Not all of the participating pharmacies returned three completed record sheets; 13 sheets in total were received from the PMR-users and 20 from the non PMR-users.

A total of 159 clinical intervention events was recorded. Of these 159 events, one event (0.6%) was associated with a group of three drugs, 65 (40.9%) were associated with a combination of two drugs and 93 (58.5%) were associated with individual drugs.

Table 7.12 shows the incidence of the use of PMRs associated with clinical intervention events in those pharmacies participating in the Phase II survey. A comparison with Table 7.6 shows that the percentage results are not dissimilar to those obtained in the Phase I survey.

Table 7.12: Phase II Study: Cross-tabulation of the use of the PMR and the type of system in use in the selected branches of the multiple pharmacy company (percentages of totals in brackets).

	PMR type:			
Was PMR used?	Computer	Manual	None	Total
Yes	77 (72)	1 (50)	0	78 (49.1)
No	30 (28)	1 (50)	50 (100)	81 (50.9)
Total	107 (100)	2 (100)	50 (100)	159 (100)

Table 7.13: Phase II Study: Number of events being associated with each clinical intervention category for PMR computer-users and non-PMR computer-users (percentages of totals, in brackets).

Intervention category	*PMR computer-users*	*Non-PMR computer-users*	*All respondents*
Prescription error-incorrect strength	18 (16.8)	12 (23.1)	30 (18.9)
Prescription error-incorrect dose	12 (11.2)	4 (7.7)	16 (10.1)
Interaction between a previously dispensed medicine and a newly-prescribed medicine	32 (29.9)	0	32 (20.1)
Prescription error-incorrect drug	10 (9.3)	4 (7.7)	14 (8.8)
Interaction between two drugs on a presented prescription	15 (14.0)	8 (12.5)	23 (14.5)
Contraindicated prescription medicine	4 (3.8)	0	4 (2.5)
Prescription errors incomplete/incorrect patient details	3 (2.8)	11 (21.2)	14 (8.8)
Emergency supply	9 (8.4)	11 (21.2)	20 (12.6)
Contraindicated non-prescription medicine	4 (3.4)	1 (1.9)	5 (3.1)
Interaction with a non-prescription medicine	0	1 (1.9)	1 (0.6)
Total	107 (100)	52 (100)	159 (100)

The incidence of each type of clinical intervention event is shown in Table 7.13, for both PMR computer and non-PMR computer users. Likewise the frequency of patient-at-risk groups associated with each event is shown in Table 7.14.

Table 7.14: Phase II Study: Frequency of patient at-risk groups being associated with clinical intervention event data for PMR computer-users and non-PMR computer-users (percentages of totals, in brackets).

	PMR computer users	*Non-PMR computer users*	*All respondents*
Geriatric	26 (24.3)	4 (7.7)	30 (18.9)
Cardio-vascular disease	24 (22.4)	10 (19.2)	34 (21.4)
Asthmatic	8 (7.5)	6 (11.5)	14 (8.8)
Young patient	3 (2.8)	3 (5.8)	6 (3.8)
Diabetic	4 (3.7)	2 (3.8)	6 (3.8)
Mentally ill	5 (4.7)	3 (5.8)	8 (5.0)
Expectant mother	1 (0.9)	-	1 (0.6)
Fits, epileptic	4 (3.7)	1 (1.9)	5 (3.1)
Parkinson's disease	2 (1.9)	-	2 (1.3)
Skin diseases	-	3 (5.8)	3 (1.9)
Peptic ulcer	1 (0.9)	-	1 (0.6)
Thyroid disorders	1 (0.9)		1 (0.6)
Ophthalmic disorders	1 (0.9)	-	1 (0.6)
Breast-feeding	-	-	-
Renal impairment	1 (0.9)	-	1 (0.6)
Hepatic impairment	-	-	-
Immuno-suppressed	-	-	-
Not listed, miscellaneous	26 (24.3)	20 (38.5)	46 (28.9)
Total	107 (100)	52 (100)	159 (100)

7.4 Discussion

7.4.1 Phase I Study

7.4.1.1 Design of the Clinical Intervention Record Sheet

In practice, the record sheet worked well and only three events could not readily be classified under the coding system. These were the processing of a totally illegible prescription form, and the use of PMRs in specific two events - an accidental nifedipine overdose and a suspected adverse drug reaction with pseudoephedrine.

The record sheet encouraged the recording of one patient condition, where applicable. This produced some disadvantages, which had not been foreseen when designing the form. Some patients have multiple disease states and may be at risk from drug therapy for more than one reason. For example, an epileptic patient with a prosthetic heart valve, who receives warfarin, phenobarbitone and phenytoin, is at a considerable risk from multiple drug interactions. If this patient is also hypertensive, then non-prescription systemic sympathomimetics are contraindicated. In some cases, it is possible that pharmacists attributed the patient to one at-risk group when the code for another group may have been equally or more appropriate.

The recording of patients as "geriatric" occurred in 330 (26.3%) of the database events, despite many of these patients obviously having other disease states. This was particularly the case when PMRs were used (33.3%) (Table 7.8). There are two possible explanations for this high percentage. First, "geriatric" is a term which is not clearly defined, and some respondents may have regarded all patients over 60 or 65 as geriatric. A second possible explanation is that pharmacists are paid to keep records for the elderly and the confused. It may, therefore, be in a pharmacist's financial interest to designate a patient as geriatric, where possible.

7.4.1.2 Response

A response of only 28 participating pharmacies was disappointing (Section 7.3.1). Many potential participants were deterred by the need to record interventions on a regular basis, over a long period of time. In particular, pharmacists qualifying before 1986 were much less disposed to participate than their colleagues who had registered more recently. The year of registration as a pharmacist again appears to influence a practising community pharmacist's clinical role (Chapter 2). The reasons for this are complex, but may relate to a stronger self-perception among younger community pharmacists of a clinical role that has been developed by undergraduate education, and the participation or otherwise in postgraduate continuing education.

The mixture of independent and multiple pharmacies did not differ significantly (χ^2 analysis) from the 744 pharmacies that participated in our original survey.

7.4.1.3 The Use of PMR Systems

The low number (six) of respondents not using a PMR system initially hindered comparisons, since a much larger group of 15-20 pharmacies ideally would be needed as a control. This problem was overcome by undertaking the Phase II study. On reflection, it is not surprising that the number of non-users participating in our study is low, since it is probable that those pharmacists who were interested in clinical patient care, and therefore interested in taking part in a survey on the subject, have already purchased a computerised PMR system.

Only three of the participants were using a manual record system. Despite the small number, this group provided a valuable contrast with users of computerised systems when examining the percentage of intervention events during which the PMR system was used (Table 7.6). Where the pharmacy possessed a computerised PMR system, the system was used for 80.2% of the recorded interventions. With a manual system,

this figure fell to 59.5%. These findings are significantly different (χ^2=39.62, df=1, p<0.0001). Within our limited sample size, this shows that computer-based PMRs are more intensively used than manual card-index systems. The interactive nature of some PMR systems, eg. Hadley Hutt and Park Systems is surely advantageous in that drug and patient databases constantly cross-reference and warn pharmacists when potential problems arise. The relatively small sample size did not permit meaningful analysis of differences between various computer systems in widely varying practice settings.

7.4.1.4 Patient At-risk Groups

The possibility that pharmacists may record patients as geriatrics, when it may be more appropriate to associate them with particular disease states has been discussed above (Section 7.4.1.1). Table 7.8 shows that patient at-risk groups associated with a high frequency of clinical intervention events are those suffering from cardiovascular disease, asthma and diabetes. Excess morbidity may be associated with the use of contraindicated drugs in these patient groups. Both the supply of inappropriately prescribed medication and the sale of contraindicated non-prescription medicines are likely to have adverse effects in these patient groups.

It is a legal requirement under the Medicines Act 1968 for prescribers to indicate the age of children under 12 when prescribing prescription-only medicines. However, Rogers *et al* have reported that this requirement is not always complied with.[127] The results in Table 7.8 show that young patients are at risk from prescribed overdoses. Clearly, it is of benefit to this group of patients if, by maintaining medication records, pharmacists are able to prevent morbidity associated with prescribed overdoses, particularly when there is no indication of the child's age on the prescription form. Our findings support the work published by Paes in Holland, which showed a high frequency of inappropriate doses being prescribed for children.[128]

Pharmacists are able to claim a fee for maintaining records for elderly and confused patients. Results demonstrated in this study present a strong case for the provision of fees for keeping records for other at-risk patient groups.

7.4.1.5 Prescription Errors

Table 7.7 shows the variety of events in the database. Over 50% of the events consisted of the wrong drug, strength or dose being written on a prescription form. In the case of strengths and doses, many examples were omissions rather than errors. Where an incorrect drug was prescribed, another drug from the patient's records at the general practice surgery had sometimes been prescribed in error, thus inconveniencing both patient and pharmacist during the provision of repeat medication. However, in many instances serious harm to the patient could have resulted. For example, the use of PMRs by pharmacists prevented the incorrect dose of digoxin being dispensed on 17 occasions: 15 incorrect strengths and two incorrect dose frequencies, and a morphine overdose was detected by a pharmacist albeit not using a PMR system. On two occasions, a potentially serious overdose of theophylline or a theophylline derivative was prevented in a paediatric patient. In 1992, the Committee on Safety of Medicines has recently advised on the appropriate use of the non-sedating histamine H_1-receptor antagonists terfenadine and astemizole.[129] Following the publication of that advice, 11 potential overdoses of terfenadine and one of astemizole were reported. Predictably, other drugs known to have a narrow therapeutic index were prescribed in error in terms of excessive dose: lithium (twice), carbamazepine, phenytoin and primidone. Recombinant human erythropoietin is used to treat anaemia associated with erythropoietin deficiency in chronic renal failure.[81] It may be prescribed on a complex dosage regimen, with potential for the prescribing or dispensing of an incorrect strength. On two occasions, the use of a PMR system by pharmacists prevented the supply of incorrect strengths of the erythropoietin products *Eprex* and *Recormon* to renal patients.

Incorrect use of a general medical practice computer system produced a prescription for Co-proxamol Tablets, 11 *prn,* which was intercepted by a pharmacist without the use of patient records. This example illustrates the fact that pharmacists almost certainly will notice obvious errors, and probably detect prescribed overdoses, both without the use of PMRs. However, especially where drugs have a low therapeutic index, the use of a PMR system is likely to prevent incorrectly prescribed strengths being dispensed to patients, thus enhancing patient outcomes, e.g. in the case of the digoxin examples.

It is the opportunity to intervene when the wrong drug is prescribed that particularly justifies the use of PMRs. The use of computerised systems helped to prevent the dispensing of the non-steroidal anti-inflammatory drug *Rheumox* (azapropazone) instead of the homoeopathic product Rhus Tox on three occasions where a doctor's receptionist had misinterpreted a doctor's handwriting. In a similar example, the proton-pump inhibitor *Losec* (omeprazole) was prescribed instead of the loop diuretic *Lasix* (frusemide); again this was due to a probable misinterpretation of handwriting at the surgery. Three examples were recorded of quinidine salts being prescribed in place of quinine salts; in each of these three cases, mis-selection of a drug on a prescriber's computer screen was the cause of the error.

This survey illustrated a very alarming type of prescription error, which the PMR-user is well-placed to prevent. Many general practitioners are now changing their prescribing policies, in that they now prescribe by generic drug name when possible, whereas formerly the proprietary brand name was normally used on prescription forms. There is a risk of error when the same drug is prescribed generically in addition to a prescription by proprietary name. This may happen when a patient's drug regimen is reviewed, for example, if repeat prescription items are changed from proprietary to generic name and the original proprietary products not deleted. Such errors may not

be detected by the patients, because proprietary and generic examples of the same medicine may differ in appearance, as well as by name. Two examples of this type of error were detected in our survey. In the first example, *Univer* and verapamil were prescribed together when a doctor switched to generic prescribing without removing the proprietary product from the patient's current record. This error could have caused severe hypotension, heart block or even accidental death through ventricular fibrillation. In the second example, *Melleril* and thioridazine were co-prescribed. These errors also illustrated the need to maintain correctly computerised records at the general practice surgery.

Errors due to the use of the wrong approved-name of generic combinations with the *Co-* prefix were detected in three cases relating to the analgesic combinations Co-proxamol (dextropropoxyphene and paracetamol), Co-codamol (codeine and paracetamol) and Co-dydramol (dihydrocodeine and paracetamol). In other examples, the diuretic combinations Co-amilozide (amiloride and hydrochlorothiazide) and Co-amilofruse (amiloride and frusemide) were transposed. This is evidence that the *Co-* prefix in approved names causes confusion; vigilance is therefore required when pharmacists are presented with prescriptions for such products. This evidence confirms Lawrie's concerns.[130]

Another example, where a computerised PMR system prevented the possibility of iatrogenic illness, was a patient suffering from angina who required isosorbide dinitrate, but was prescribed the anti-tubercular drug isoniazid in error. Another patient needing co-proxamol was prescribed captopril. One patient, suffering from angina requiring the calcium-channel antagonist *Tildiem* (verapamil) was prescribed the histamine H_1-receptor antagonist *Triludan* (terfenadine). Other potentially serious errors detected by the use of a PMR system were the prescribing of the tricyclic anti-depressant clomipramine instead of the histamine H_1-receptor antagonist chlorpheniramine, and a hay fever sufferer requiring the corticosteroid nasal spray

Dexarhinaspray being prescribed the vasopressin analogue *Desmospray*. Another example where a patient could have suffered, through a hand-writing error, was the prescription of the anti-thyroid drug carbimazole when the anti-epileptic carbamazepine was required. Loss of epileptic control could have had serious consequences for this patient, and possibly for others if that patient held a driving licence.

Of the serious errors detected without the use of a PMR, the prescribing of the major tranquilliser pimozide instead of pizotifen for the prophylaxis of migraine, was of particular note. The use of a PMR system alerts pharmacists to these major errors before the patient may be aware that anything is wrong. Such errors are much less likely to be identified without the use of a PMR system. If prescription forms containing such errors are to be intercepted without the use of a PMR system, then reliance is placed on the pharmacist's personal knowledge about a patient, or on a patient's ability to detect the error. Clearly, PMRs will only be an effective safeguard where patients regularly visit the same pharmacy. This point, of course, is a very strong argument in favour of either patient registration with a particular pharmacy or the community pharmacist having access to a patient's medication history through a modem link or by means of a smart card.

The classification M4 in Table 7.1 covered incorrect patient details. Nothing of unusual note was found with this group of interventions. The correct standard procedure of checking a patient's name and address against a prescription should filter out such errors in any case. The fact that 110 such prescription errors were documented reinforces the need for pharmacists and their staff to be vigilant through the use of systematic procedures when receiving prescription forms.

7.4.1.6 Drug Interactions

Potential drug interactions accounted for 510 (27.3%) of the recorded interventions. Interactions with previously dispensed medicines were noted in 278 of the 510 cases; of these only 19 were identified without the use of a PMR. The patient's therapy was altered as a result of the pharmacist's intervention in 30 of these 278 cases (10.8%), as documented in Appendix 3. This illustrates a *raison d'être* for the use of PMRs. It is very difficult to monitor for the possibility of drug interactions with previously dispensed medication without the use of records. A pharmacist must first enquire about other medicines that are being taken, then find a reference source to check for potential interactions. Assuming that a patient takes all their prescriptions to the same pharmacy, and that full records are maintained by that pharmacy, a computerised system with software for drug interaction monitoring will automate this task. The results suggest that pharmacists not using PMR systems are putting patients at risk from drug interactions. Taking this point further, one could argue that pharmacists could be considered negligent by not using PMRs if harm came to a patient as a result of a preventable drug interaction. It has been shown that drug interaction monitoring software is not widely used by GPs, despite widespread computerisation.[131,132] This places further responsibility on the community pharmacist.

Of the 387 cases where a PMR was used to establish a drug interaction, 136 examples involved drugs which affect the cardiovascular system. This therapeutic category produced several examples which illustrate some of the advantages and pitfalls of using PMRs. Co-amilofruse when taken with the angiotensin-converting enzyme inhibitor captopril may lead to hyperkalaemia[109]; in this instance, the pharmacist recommended the substitution of co-amilofruse with frusemide, which the GP accepted. In a similar example, the potassium supplement *Slow K* was discontinued when treatment with captopril was initiated. In many examples therapy was not altered because patients were said to be stable, albeit often on hazardous combinations of drugs, eg. digoxin and verapamil.[59] One can regard the figure of 10.8% change in therapy in two ways.

On a national level, if this figure was applied to all significant interactions detected by pharmacists' PMR systems, the clinical contribution of community pharmacists in this area could be viewed as considerable. Conversely, the percentage may be regarded as low; which could be due to many pharmacists not being sufficiently assertive towards GPs, or because some pharmacists are unaware of the potential consequences of interaction, or possibly a result of GPs' ignorance. This is a subject worthy of further research.

Interactions between broad-spectrum antibiotics and previously-prescribed oral contraceptives were found 128 times in the database: this was the most common potential drug interaction. This finding corresponds, in part, with the work published by Rupp, which showed that anti-infective agents and hormones are the drug groups most frequently associated with intervention events.[120] While the true significance of the interaction between broad-spectrum antibiotics and oral contraceptives is unclear[59], the high frequency illustrates the need for pharmacists to record the supply of oral contraceptives, and to provide appropriate advice when dispensing broad-spectrum antibiotics. Women of child-bearing age are not usually considered an "at-risk" group, unlike diabetics or asthmatics, nor have they been considered to warrant special attention in the context of pharmacy-maintained records, unlike the elderly or confused. However, the level of intervention reporting observed in this study shows that comprehensive records are required, even if the only requirement for medication in this group may be short-term anti-bacterial therapy. Other interactions recorded included several cases of drugs affecting liver microsomal enzymes, eg. erythromycin, phenytoin and cimetidine.

The 197 cases of two interacting drugs, both written on the same prescription form (event code I1), produced similar examples of potential drug interactions to those cases listed above. Fifteen cases (7.6%) of the 197 resulted in the patient's medication being altered. These included a prescription for the monoamine-oxidase inhibitor

phenelzine and the tricyclic antidepressant amitriptyline where, after consultation with the prescriber, amitriptyline was not dispensed. A further 15 (7.6%) of the 197 examples in the I1 interaction group involved the macrolide antibiotic erythromycin, including two cases of a potential terfenadine-erythromycin interaction. Erythromycin, through inhibition of hepatic microsomal enzymes, reduces the metabolism of many drugs, including warfarin.[81] Despite being a well-documented interaction, one GP refused to monitor a patient's prothrombin time when recommended to do so by the pharmacist who noticed a potential interaction between warfarin and erythromycin.

The final group of interactions considered was the group coded I3, involving non-prescription medicines. Together with the contraindicated non-prescription medicines, coded C2, only 101 cases were recorded. Either there has been considerable under-reporting of this type of intervention, or the pharmacists in our survey were giving little consideration to the problems associated with non-prescription medicines. Our earlier survey showed that only 35.5% of our sample of 744 pharmacists ever recorded any non-prescription products in their PMR system (Table 2.34).[65] However may interventions related to non-prescription medicines were significant. In this present study, 41 examples were associated with the non-supply of sympathomimetic decongestants to patients with cardiovascular diseases. There were also four notable examples of requests for hyoscine-containing products (e.g. *Kwells*) for glaucoma sufferers. Anti-cholinergic drugs, eg. hyoscine are contraindicated in patients with closed-angle glaucoma.

In view of the current trend to make certain prescription-only medicines available through pharmacies without prescription, the low reporting of both the recording of the supply of, and the documentation of interaction with non-prescription medicines is of some concern. Community pharmacists probably need to have a greater awareness of the potential for drug interactions with non-prescription medicines that are sold to patients.

7.4.1.7 Problems With Drug Interaction Monitoring Software

Two examples of incorrect information being produced by PMR systems were noted. Loop diuretics, for example, bumetanide, increase the nephrotoxicity of cephalothin, an obsolete first generation cephalosporin.[133] However, one large multiple pharmacy company's system classified all cephalosporins as interacting with all loop diuretics; and as a result a false interaction was indicated between *Burinex K* and cephalexin, the outcome of which was that antibiotic therapy was stopped prematurely. This example demonstrates the need for drug-specific interactions to be distinguished from interactions between pharmacological classes of drugs, when programming drug interaction databases.

All drug interaction software, currently available in the UK, monitors for the possibility of interaction by examining pairs of drugs in turn, for example four drugs prescribed concomitantly will be examined as a permutation of six drug pairs. Our results included a report of an interaction between frusemide and digoxin. However, when the pharmacist concerned investigated this, he found that the patient was also taking *Slow K* which would overcome the potential problem of hypokalaemia caused by the loop diuretic. The combination of frusemide and digoxin was therefore acceptable given the concurrent administration of *Slow K*. Systems must be developed in future to consider the suitability of a patient's total combination of current medication in one examination process.

7.4.1.8 Emergency Supplies

Emergency supplies were recorded 106 times, the most common example being salbutamol which was requested on 25 (23.5%) occasions. Miscellaneous products acting on the cardiovascular system were requested 36 times. The use of a comprehensively maintained PMR system can enable the pharmacist to fulfil his

professional and legal obligations when making emergency supplies at the request of a patient.

7.4.1.9 "Problem" Categories of Medicines

Table 7.9 shows a summary of the BNF classification of all products associated with the interventions recorded in the database, together with prescribing frequency derived from data supplied by the Department of Health. The Table shows a calculated factor *a/b* which is the percentage frequency, *a*, with which a drug in a particular BNF category of drug occurs in our database, divided by the percentage frequency, *b*, of all NHS prescription items for that given category during 1990. For example, an *a/b* ratio greater than 1.25 indicates that a particular category of drugs has presented over 25% more problems than would be anticipated. The purpose of our factor *a/b* was to standardise our findings against national dispensing figures. Our recording of a large number of interactions between antibiotics and oral contraceptives is reflected in an *a/b* ratio of 3.13 for drugs classified as "obstetrics, gynaecology and urinary tract," encompassing Chapter 7 of the BNF which includes oral contraceptives. The high *a/b* ratio of 1.56 for malignant disease and immuno-suppression may be spurious, due to the low number (seven) of intervention events reported for this group. However, this finding could be a reflection of the highly toxic nature of many of the drugs included in this category of the BNF.

The most notable from these figures are the drugs affecting the cardiovascular and respiratory systems, both of which presented in a number of different types of intervention. The cardiovascular drugs have considerable potential for pharmacodynamic interaction, which is reflected in our results. The frequent problems involved in the medication of asthmatic patients are also reflected in our data. For example, there are many potential drug interactions with theophylline and its derivatives.[59,81,106] Problems exist with both contraindicated prescription and non-

prescription medicines, for example, propranolol and ibuprofen, both of which may induce bronchospasm. Requests for emergency supply of bronchodilators are common, due to the unpredictable nature of mild acute asthmatic attacks in many patients.

The low ratio *a/b* of 0.22 for dermatological products reflects few contraindications and a low potential for interaction with topically administered drugs.

Application of our calculated ratio *a/b* could prove useful in education of health professionals about the potential for, and incidence of, adverse reactions, interactions, and potential prescribing errors. An important advantage of this parameter in evaluating the effects of these medication problems is that it normalises the results with respect to the extent to which a particular category of drug is used. In this study, we have considered the use of the ratio *a/b* based on broad complete BNF categories. In future work, the ratio *a/b* could be used to compare BNF sub-categories, for example, beta-blockers and ACE-inhibitors.

7.4.2 Phase II Study

The response from the pharmacies in the Phase II study was disappointing. Only 16 (53.3%) of the possible 30 pharmacies returned any completed forms. All non-respondents were contacted again and reminded to return data. Reasons given for not making a return included being too busy, or giving this task a low priority. It is probable that the explanation for the poor response was that this group of 30 pharmacists could be regarded as "conscripts" rather than "volunteers", unlike those participating in the main survey.

Where PMR systems were available, the proportion of clinical intervention events associated with PMR use was 72% for computerised systems and 50% for manual systems (Table 7.12). This compares with 79.8% and 48.8% respectively from the

main study (Table 7.6). Despite the low numbers in the large-multiple pharmacy group, the results are very similar.

The poor response and low number of returned clinical intervention event record sheet made a rigorous statistical analysis of the results impossible. However, important trends can still be observed. Table 7.13 shows that 107 events were recorded by computerised PMR-users on 13 record sheets, i.e. a mean of 8.2 events per six-week form. In comparison, 52 events were recorded by non-computerised PMR-users on 20 record sheets, i.e. a mean of 2.6 events per form. Thus, clinical intervention among the group of computerised PMR-users would appear to be considerably higher than in the control group of non-computerised PMR-users.

The nature of the events recorded in the Phase II study is shown in Table 7.13. Most of the interventions associated with non-computerised PMR-users involved incorrect prescription details (M1-4). No interactions with previously dispensed medication were reported by the non-computerised PMR group. In contrast, interactions with previously dispensed medication accounted for 29.9% of the interventions in pharmacies running the computerised PMR system. This result accords with, and reinforces, the finding for the same intervention category in the national survey (Table 7.7).

Patients' clinical conditions associated with intervention events are shown in Table 7.14 for the Phase II survey. This may be compared with Table 7.8 for the Phase I study. The results for PMR-users are similar in each case. The six patient groups which feature predominantly in both tables are: those with cardio-vascular disease, geriatrics, asthmatics, the mentally ill, diabetics and young patients. Pharmacists receive fee payment if they keep records for 100 elderly and confused patients.[60] All groups of pharmacists in these two studies also reported a relatively high number of clinical interventions associated with four other patient groups. On the basis of these results a

case could be made for widening the scope of this fee payment provision to include patients with cardio-vascular diseases, asthmatics, the young and diabetics.

7.5 Conclusions

1. This study has shown the important benefits of community pharmacists monitoring patients' therapy and intervening when appropriate. The survey has also demonstrated the feasibility of documenting such interventions in a busy community pharmacy.

2. Community pharmacists using computer-based PMR systems intervene more frequently than their colleagues using manual card-index systems.

3. NHS remuneration to pharmacists for maintaining records for the elderly and confused needs to be extended. Other patient groups are also at special risk from drug-related morbidity. The nature of interventions made by pharmacists demonstrates the need to maintain records for those patients with cardiovascular disease, asthmatics, diabetics and the young. Consideration should be given to the introduction of an ethical requirement for pharmacists to utilise PMRs for these and other defined groups of patients.

4 PMRs are of particular benefit in monitoring for potential drug interactions between previously-dispensed and newly-prescribed medication. Where interacting drugs are prescribed for a patient but not on the same prescription form, pharmacists not using PMR systems may be exposing their patients to risk from adverse drug interactions.

5. A potential problem of inadequate performance of drug interaction monitoring software has been detected. Deficiencies have been brought to our attention where systems failed to consider a patient's medication as a whole, and where non-existent interactions were reported.

6. A factor *a/b* has been calculated to reflect the frequency, normalised against national prescription data, with which therapeutic classes of drugs have been associated with clinical interventions. Use of the calculated factor *a/b* enabled the prediction of those therapeutic categories of drugs like to present potential adverse drug problems. Pharmacists must remain especially vigilant when dispensing such medicines, which include drugs used in malignant disease and oral contraceptives.

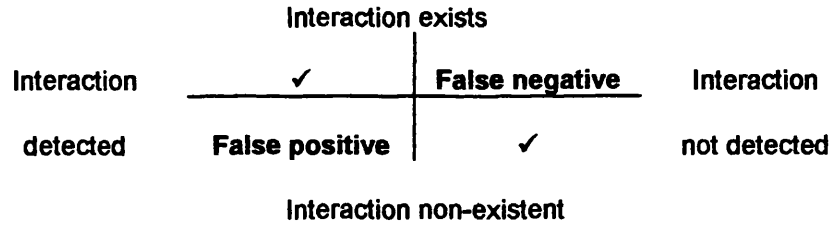
7. This study has highlighted the importance to the patient of the pharmacist having access to complete patient medication records at the time of dispensing a prescription or supplying a non-prescription medicine. Optimum benefit to patients would be achieved if they were required to register with a particular pharmacy, or if their pharmacist had access to comprehensive patient medication data on a smart card or via a modem link to computer records stored elsewhere.

8. Problems Associated With Drug Interaction Monitoring Software

8.1 Introduction

The issue of false positive drug interaction warnings being reported by pharmacy computer systems has been raised in Section 7.4.1.7. As part of the study into pharmacists' use of PMR systems to monitor for potential drug interactions, a serious problem was uncovered whereby a computer system used by a large multiple pharmacy company reported an interaction between all loop diuretics and all cephalosporins. This is an example of one type of error that can occur with drug interaction monitoring software. The other type of error is a false negative report, when a computer system fails to detect a potential drug interaction that actually exists. Both types of error are illustrated diagrammatically in Figure 8.1.

Figure 8.1: Diagrammatic representation of errors presented by drug-interaction monitoring software.



Given that many pharmacists stated the need for the availability of drug interaction monitoring software as a prime reason for installing PMR systems (Section 3.3), it is surely reasonable for them to expect that the system they purchase or lease has drug interaction software that functions reliably. Indeed, in the Royal Pharmaceutical Society's guidelines on the use of pharmacy computer systems, it is recommended that "information should be obtained from a reputable source with a guarantee that it is regularly updated."[134]

8.1.1 What is a Drug Interaction?

Stockley has defined a drug interaction as "a modification of the effect of one drug by the prior or concomitant administration of another."[59] A fuller description has been given by Maurer and Bartowski as follows[135]: "A drug interaction is considered to be the modification of one drug by prior or concomitant administration of another." In order to observe a clinically significant drug interaction there must be an alteration of the expected pharmacological outcome of individual drugs when used in combination. If the resultant response is greater than the sum of their separate actions then potentiation has occurred, while if the overall result is less than expected this development can be regarded an antagonism." Drug interactions can be conveniently divided into those affecting the pharmacokinetics of a drug and those that affect the pharmacodynamic responses.[136]

Drug interactions can be regarded as encompassing three distinct groups of problems: drug-drug interactions; drug-food interactions; and drug-clinical-condition interactions. Drug-food interactions have not been considered as part of this research project, and the use of PMR systems to monitor for drug-patient-condition interactions (ie. contraindications) has been described in Chapter 7. In the following examination of drug interaction monitoring software, only drug-drug interactions have been considered.

8.1.2 The Availability of Drug Interaction Information to Community Pharmacists and General Medical Practitioners

Primary information sources on potential drug interactions include the following: published research papers; published clinical reports, for example a recent report on a probable terfenadine-itraconazole interaction[137]; letters to professional journals; manufacturers' data sheets; and *Current Problems*, issued by the Committee on Safety of Medicines.

Community pharmacists and GPs have available to them a variety of reference sources to check for potential drug interactions, in addition to the possible use of a computer system. Probably, the most widely used paper-based information source on drug interactions in the UK is Appendix 1 of the British National Formulary[81], which is published twice-yearly. Drug interaction information is also provided in each monthly issue of MIMS (Monthly Index of Medical Specialities).[138] Each of these publications is received by large numbers of community pharmacists and GPs. Many UK community pharmacies will have an up-to-date edition of the comprehensive text Martindale.[133] Specialist drug interaction texts are also available, including Stockley's book *Drug Interactions*[59], and in the United States two loose-leaf volumes containing drug interaction literature.[106,109] Other secondary literature-based sources of drug interaction information include published reviews, for example those covering specific pharmacological classes[135,139], therapeutic groups[140], and recently-documented interactions[141-143], although such sources are usually less readily available to community-based practitioners, within their practice environment. The results of a survey investigating GPs' use of drug interaction information sources are presented in Section 9.3.

8.1.3 Secondary Reference Sources on Drug Interactions

A description of the *modus-operandi* of four paper-based drug interaction reference sources is given below.

8.1.3.1 The British National Formulary

The BNF[81] is jointly published, twice a year, by the British Medical Association and the Royal Pharmaceutical Society of Great Britain, and includes an appendix providing brief drug interaction information which is cross-referenced. Interactions are classified at two levels of importance. Certain interactions are highlighted, indicating that they

are potentially hazardous or that combined administration of two drugs should be avoided. Others are stated as not usually having hazardous consequences.

The BNF is compiled under the auspices of the Joint Formulary Committee, currently chaired by Professor CF George FRCP. The inclusion of drug interaction information is co-ordinated by the Executive Editor, currently Mrs Anne Prasad FRPharmS. Drug interaction information sourced from the pharmaceutical industry, published papers, other secondary reference sources and clinical reports, is reviewed by members of the Executive Committee, with expert opinion being sought from outside specialists. In the case of each new suspected drug interaction, or the review of a previously included interaction, expert advice is normally sought from a clinical pharmacologist, recognised for her work in the field. In addition, expert advice is sought from a specialist clinical practitioner working in the field concerned, for example a consultant cardiologist would normally advise on suspected interactions between two cardiovascular drugs.

8.1.3.2 Martindale: The Extra Pharmacopoeia

Published by the Pharmaceutical Press, and currently in its 30th edition, Martindale[133] has recently been published every four to seven years. Consequently, the paper-based version of Martindale cannot be considered as an adequate reference source for up-to-date drug interaction information, except perhaps for a short period after publication. An on-line, computerised version of Martindale is available, and is continuously updated;[144] a CD-ROM based version is also available. Martindale differs significantly from the BNF, in that only published papers are included in the drug interaction monographs. In contrast to the BNF independent expert clinical opinion on drug interactions is neither sought nor included.

8.1.3.3 Drug Interactions (Stockley)

The second edition of this specialist text on drug interactions was published in 1991.[59] The first edition was published in 1981. This book is a result of the work of Dr Ivan Stockley, a recognised expert on drug interactions. It is a compendium of monographs on drug interactions, for which there have been published reports. An opinion of the significance of each potential interaction is provided. While, comprehensive in its nature, the infrequent publication of this work renders it out-of-date soon after publication.

Boehringer Ingelheim Ltd., with Stockley's guidance, publish a chart-based information system (Drug Interaction Alert) for doctors and pharmacists.[25] It is not comprehensive, but provides an aide-memoire giving information about interacting drug pairs. The chart indicates whether drug effects are likely to be increased or decreased, as a result of a drug interaction, whether an interaction may be dangerous, or whether a toxic reaction is produced. Interactions are given three levels of significance: those of major or potentially serious significance; those of moderate or minor significance; and those of unclassified importance.

8.1.3.4 Evaluations of Drug Interactions

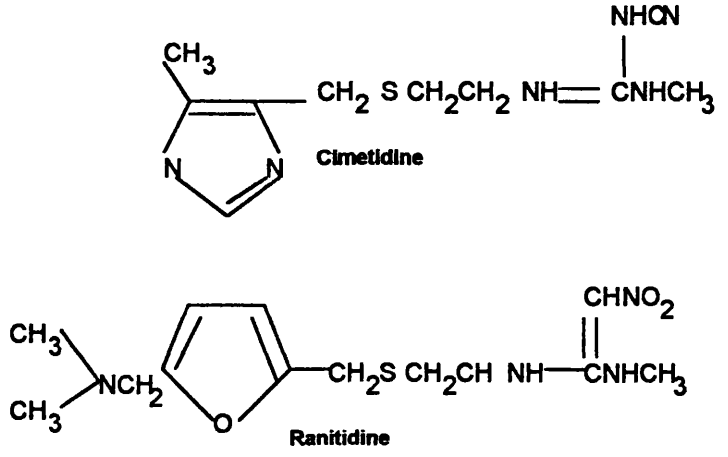
Evaluations of Drug Interactions (EDI)[109], published by Professional Drug Systems Inc., is similar in its philosophy to *Drug Interactions*.[59] Primarily intended for use in the USA, and endorsed by an American Pharmaceutical Association (APhA) Scientific Review Panel, EDI has two important advantages over *Drug Interactions*. First, it is in loose-leaf format and bimonthly updates are issued to subscribers of the volume. Second, information is sourced from a number of academics and practising pharmacists. Drug interaction information is reported by consultant contributors and reviewed by an inter-disciplinary review panel and by the APhA Scientific Review Panel. Judgements on the inclusion and rating of monographs are made on the basis of

levels of documentation, likely prevalence, and predicted severity. Interactions are ranked, based on these factors, from one (highly clinically significant) to four (not clinically significant). EDI is used as a reference source by Hadley Hutt Computing Ltd. for their *PILLS* system (Section 2.4.11).

8.1.4 The Development of Drug Interaction Monitoring Computer Software

The use of a program, written in the FORTRAN language, to store and retrieve drug interaction information was described by Lowenthal.[145] The use of computer algorithms, based on the use of BNF drug classifications to determine drug-drug interactions has been described by workers at Liverpool University.[146] Their work considered "interaction groups", based on BNF classifications. Such a method of classifying drug groups, on its own, is insufficient to produce reliable drug-interaction monitoring software, since such BNF-based interaction groups are not usually drug-specific because they take no account is made of the effect of a drug's structure. The example of drug interactions with the histamine H_2-antagonists cimetidine and ranitidine (Figure 8.2) illustrates this point.

Figure 8.2: Structures of two histamine H_2-receptor antagonists, cimetidine and ranitidine.



Cimetidine inhibits the cytochrome P450 in the liver microsomal enzyme system, whereas ranitidine, and the other histamine H_2-receptor antagonists famotidine and nizatidine do not.[147] Cimetidine is bound to cytochrome P450 and forms a stable complex, preventing the access of other agents to the cytochrome P450 enzyme system. It has been proposed that the particular ability of cimetidine to inhibit the hepatic metabolism of other drugs may be due to the imidazole ring in its structure.[148] This structural feature is not shared by ranitidine or the other histamine H_2-receptor antagonists famotidine and nizatidine. Therefore drug interaction groups used to code for interactions with histamine H_2-receptor antagonists must take account of differences in each drug's activity, produced as a function of chemical structure, and not simply rely on the BNF classification 1.3.1 "Histamine H_2-receptor antagonists."

The use of Prolog to produce a drug-to-drug interaction package has been described by Pinciroli and Pozzi.[149] Gardner and Rizack have used a Prolog knowledge base, which consisted of two databases: the first of drug interactions, and the second of drug chemical names and structures.[150] They used this knowledge base to examine the relationship between interacting drugs and their chemical components. The problems of interfacing a drug interaction monitoring program to pre-existing medical records has been described by Dolin.[151] He used a Pascal program to store medical records in a dBase-compatible format (Ashton-Tate Ltd.), which was then linked to a commercially available drug interaction monitoring program. Some pharmacy computer programs store their drug-product data in a dBase-compatible format, for example, the *Nomad* program produced by Surgichem Ltd.

8.1.5 Evaluation of Drug Interaction Monitoring Software

The value of a computer application is usually dependent on the program's ability to store, process, and retrieve information in a format that is useful to the computer user.[152] To date, there has been no published work in the UK evaluating the ability of pharmacy computer systems to detect drug interactions, although Stevens and Crabbe discussed the nature of interactions detected in a community pharmacy over a one-month period by the Interlex system, used as part of the AAH *LINK* system.[28] The use of hospital-based drug interaction monitoring software in the USA has also been described.[153]

A number of papers have been published as a result of work in the USA, examining the abilities of various software packages to detect potential drug interactions. Poirier and Guidici have evaluated 11 American drug interaction monitoring programs.[154-164] When evaluating each program, they considered ease of installation, learning and use; documentation; and the provision of technical support. The ability to detect ten potential drug interactions was tested. A final paper was published summarising and comparing each system.[163] Fox published a paper evaluating three systems in 1991[152], and, most recently, Jankel and Speedie evaluated and compared six systems, concluding that for those interactions examined, the *Medicom Micro Plus* system (PDS Inc.) was the most reliable.[166] The ability to detect drug-food interactions has also been evaluated in one paper.[167]

8.1.6 Sources of Drug Interaction Information Used by UK Pharmacy Computer Systems Suppliers

In commenting on the RPSGB guidelines on pharmacy computer use[134], Strickland-Hodge has summarised the criteria essential for an effective drug interaction system.[27] These were as follows:

i) The system should recognise proprietary and generic drug names and be able to identify individual drug constituents within compound preparations.

ii) Drug interaction information should be obtained from a reputable source.

iii) Drug interaction information should be updated on a regular basis in electronic form.

iv) The pharmacist should be able to set the time period over which the patient record is searched for interactions and this period should extend up to two years if required.

Interaction reference sources that were cited within the five systems with the largest UK market shares in April 1991 (Figure 2.3) are described below.

8.1.6.1 John Richardson Computers Ltd.

The drug interaction information within the Richardson system has been compiled by Richardson staff with input from Dr Ivan Stockley. Recently, the VADIS database has been included with this system.[168] The Richardson system does not provide any ranking of the significance of reported drug interactions.

8.1.6.2 AAH *LINK*

The AAH *LINK* system uses the *Philex* and *Interlex* databases produced by Exeter Data Base Systems Ltd. The *LINK* system gives interaction guidance to pharmacists as in Figure 8.3.

Figure 8.3: Drug Interaction Guidelines Given to Pharmacists by the AAH *LINK* Computer System.

Key: **** Most Severe * Least Severe

Suggested Action:

**** *Hold script and contact GP*

*** *Dispense script but inform GP*

** *Dispense script & counsel patient*

* *No specific guidelines - actions dependent on circumstances*

8.1.6.3 Park Systems Ltd.

Interaction information within the Park Systems program is provided by staff from the School of Pharmacy, John Moores University, Liverpool. Interactions are designated "1: Major", "2: Moderate" or "3: Minor", in decreasing order of significance.

8.1.6.4 Hadley Hutt Computing Ltd. *PILLS* System

The *PILLS* system cites drug interaction information from the following sources: BNF (Section 8.1.3.1); *Drug Interactions*; the *British Medical Journal*; drug manufacturers; *Adverse Drug Reaction Bulletin*, produced by the Adverse Drug Reaction Research Unit at Shotley Bridge General Hospital, Consett, Co. Durham, UK; USPDI[108]; *Evaluations of Drug Interactions* (Section 8.1.3.4).[109] Each drug interaction warning brought to the user's attention is referenced to one of these sources. Interactions are classified by the *PILLS* system as either "Probable" or "Possible": the former being those rated as being of greater significance.

8.1.6.5 Chemtec Systems Ltd.

The *Alchemist 3000* system includes interaction information from the following sources: Hansten & Horn[107], BNF[81], Martindale[133] and the *Pharmaceutical Journal*. Interactions are ranked as follows, in decreasing order of significance:

dangerous, moderate, minor. The user has the facility to switch off the lower levels of significance, but those interactions ranked as dangerous require the pharmacist to enter a password in order to proceed.

8.2 Method

The study on clinical interventions made by community pharmacists (Chapter 7) produced a total of 510 reported drug interactions (Table 7.7), of which 364 occurred during the period August 1991 - July 1992. Of these 364 reported incidents, 168 were duplicate interactions which had each occurred on more than one occasion. Therefore, at the time of the following study on drug interactions (July-August 1992) there were 196 reported discrete drug interactions contained within database of the clinical intervention events. Each of these interacting drug pairs was input to the five PMR computer systems described in Section 8.1.4, and any computer output was noted. At the same time, each interacting drug pair was examined in four published reference sources: BNF[81], Stockley's Drug Interactions[59], Martindale[133], the ABPI Data Sheet Compendium.[169]

8.3 Results

The reporting of drug interactions by each of the five PMR computer systems and four published reference sources is shown in Appendix 4 (page 338). The data are presented in order of the numerical BNF classification of the first drug of each interacting pair, italics being used to identify branded combination products, without an equivalent generic description, for example, *Sotazide*.

An examination of the results in Appendix 4 shows that the systems and reference sources employed are far from consistent in reporting potential drug interactions. Of the published reference sources, the BNF and *Drug Interactions* included the greatest number of reported interactions; and, of the computer systems the Richardson system reported far fewer interactions than any of the other four PMR systems. It is of note that the Hadley Hutt *PILLS* system most closely follows the guidance on drug interactions given in the BNF.

8.4 Discussion

Some reasons for discrepancies between the systems are described below, with appropriate illustrative examples, from the results of the clinical intervention study (Chapter 7), where appropriate. Interactions that are discussed in the following text are highlighted in bold in Appendix 4, page 338.

8.4.1 Inappropriate Drug Groupings

The problem of false positive drug interaction reports has been introduced in Section 7.4.1.7, with reference to the incorrect grouping of all cephalosporins which caused a PMR system to report a non-existent interaction between cephalexin and *Burinex K* (bumetanide & potassium chloride). In fact, cephalothin is the only cephalosporin which interacts with loop diuretics.[133]

A further report on the inappropriate use of interaction groups occurred with the non-steroidal anti-inflammatory drug ibuprofen. One pharmacist, using the Park Systems program reported a detected drug interaction between ibuprofen and warfarin. As a result, the general practitioner ceased the patient's ibuprofen treatment. The literature shows considerable evidence for the potentiation of warfarin by ketoprofen, mefenamic acid, tiaprofenic acid, suldinac and piroxicam, possibly through the displacement of warfarin from plasma proteins by the NSAID molecules.[59] In addition, indomethacin has been shown to reduce platelet aggregation, thereby prolonging bleeding if it occurs. In contrast, ibuprofen, diclofenac, fenbufen, naproxen and tolmetin have been shown not to interact with warfarin.[59,109]

Of the computer systems examined, Park Systems' program ranked the possible ibuprofen/warfarin interaction as a major interaction, the *Alchemist 3000* program ranked it as a moderate interaction, and the *PILLS* program ranked it as a probable interaction. Neither the Richardson nor AAH *LINK* programs detected an interaction.

It would appear that the Richardson and AAH *LINK* programs correctly considered each NSAID as a separate entity as far as interactions are concerned; whereas the other programs incorrectly are using a global interaction group to include all NSAIDs.

8.4.2 Programming Omissions

The interaction between digoxin and amiodarone is well documented.[59,108,133] Serum digoxin levels may double after administration of amiodarone, leading to possible toxicity. This interaction was ranked as being of at least moderate significance by all PMR systems, except Park Systems' program. All of the published reference sources listed in Appendix 4 included this interaction. The absence of this interaction from Park Systems' program is probably an error of omission.

Administration of potassium salts to patients taking ACE inhibitors may cause hyperkalaemia.[81] One pharmacist reported an interaction between Potassium Citrate Mixture BP and captopril. This interaction was found in all the published reference texts (Section 8.1.3), and was detected by each of the computer systems, with the exception of the Chemtec *Alchemist 3000* program. Further investigation of the *Alchemist 3000* program showed that it also failed to detect interactions between ACE inhibitors and NSAIDs, although these were detected by the AAH *LINK*, Park Systems and *PILLS* programs.

Internal audit of the drug databases by the company concerned, together with external audit by appropriate experts would help to eliminate such non-complex errors within the product files.

8.4.3 Obscure Interactions

One pharmacist, using a Richardson computer system, documented a drug interaction between co-amilofruse (amiloride & frusemide) and phenytoin. None of the other four

systems under examination detected this interaction. The interaction was not documented within the BNF or ABPI Data Sheet Compendium. However, there are literature reports describing a possible mechanism, whereby jejunal absorption of frusemide is reduced by phenytoin.[59,109] Effects of this interaction on patients, though, are not considered to be serious.[109]

Two papers were published in 1984 describing three serious cases of Stevens-Johnson syndrome attributable to the concurrent administration of captopril and allopurinol.[170,171] These papers have been used to justify the inclusion of this particular interaction in Stockley's book[59], and presumably also within the Richardson system. This interaction was documented in Martindale[133] and the ABPI Data Sheet Compendium,[169] but not the BNF.[81] No computer system, other than the Richardson detected this interaction.

8.4.4 Drug File Deficiencies

Problems can arise as a result of the drug files in computer systems not being maintained up-to-date. The vasodilator doxazosin (*Cardura*) is licensed for the treatment of hypertension, and was introduced to the UK market in October 1989, but it is not included in the current edition of *Drug Interactions*.[59] An interaction between doxazosin and co-amilozide (amiloride & hydrochlorthiazide) was reported by a pharmacist using an AAH *LINK* system. This was ranked as a "two-star" interaction, with a warning of possible increased postural hypotension caused by the diuretics. The BNF listed this interaction as potentially hazardous. The same warning was reported by the Hadley Hutt *PILLS* system. However, the Chemtec system ranked this interaction as being of only minor significance; whereas the Richardson and Park Systems' programs did not warn of any interaction. In this example, three different answers were provided by the computer systems, and one text (*Drug Interactions*) was shown to be out-of-date. This shows potential deficiencies in the ability of computer

systems to present data on new drugs. Another example of the same type of problem is the interaction between lithium and paroxetine (*Seroxat*), a new anti-depressant, marketed in the UK in February 1991. Again, paroxetine is not listed in *Drug Interactions*.[59] It was not included in Park Systems' program, which therefore could not check interactions for this product. The AAH system rated the interaction as a "one-star" interaction, and thus of little significance. The BNF described the interaction as potentially hazardous, as a result of raised plasma lithium levels. Again, the *PILLS* system matched the BNF warning, and the Chemtec *Alchemist 3000* program ranked the interaction as of moderate significance. Although both lithium and paroxetine were on the Richardson system's drug file, no interaction was indicated between the two drugs. This example illustrates a considerable discrepancy across the range of interaction reference sources, both for computer systems and published texts. The lithium and paroxetine interaction has only recently been included in EDI (June 1993).

Other potential problems exist within drug databases as a result of discontinued products. If a computer supplier deletes a product from their drug file, users of their system may not detect potential drug interactions when remaining stock is dispensed after the product's discontinuation, for example *Navidrex K*, discontinued in November 1991. *Navidrex K* had been deleted from the *Alchemist 3000* program prior to the time of this study (July-August 1992) Reported interactions between this product and indomethacin therefore could not be checked.

Non-prescription medicines, traditionally referred to as "over the counter" products are not always included in the drug files of pharmacy computer systems. Examples that could not be investigated using some of the computer systems were *Cymalon, Mucron,* and *Benylin Day and Night.* Each of these products contains drugs with significant pharmacological activity (sodium citrate, paracetamol and phenylpropanolamine), and has the potential to interact with other compounds. The potential for interactions with

non-prescription medicines (Table 7.7) again highlights the dangers if pharmacists do not make records of the supply of non-prescribed medication (Sections 2.3.4 & 2.4.10).

8.4.5 Incorrect Pharmaceutical Form

Drug interactions may, in certain cases, depend on the pharmaceutical form of one or more interacting drugs. This point is illustrated by the example of glyceryl trinitrate (GTN), which is commonly prescribed as a sublingual or buccal tablet used for the relief of acute angina. It is also used in a transdermal delivery system for angina prophylaxis. Drugs which reduce saliva production, for example, anti-cholinergics and tricyclic antidepressants. reduce the sublingual and buccal absorption of GTN.[81] However, such drugs would not be expected to reduce transdermal drug delivery. In a study of PMR systems to examine the ability of drug interaction monitoring software to detect interactions with drugs acting on the cardiovascular system, some systems failed to differentiate between different dosage forms.[172] It was found that the interaction between GTN sublingual tablets and tricyclic antidepressants was detected by all of the systems tested except the Richardson system. However, when GTN transdermal patches were entered into the AAH *LINK* system, the system still responded that the above drugs would "cause a decrease in GTN dissolution in the mouth." The Park Systems and Chemtec *Alchemist 3000* programs both gave similar warnings. Only the Hadley Hutt *PILLS* system differentiated between the dosage forms.

8.4.6 Literature Interpretation

An interaction alert between doxycycline and carbamazepine was documented by a user of an "in-house" system. This interaction has been shown to decrease the doxycycline half-life for patients receiving long term carbamazepine.[109] The effect is documented as potentially hazardous (failure of antibiotic therapy) in the BNF, and

was found in the all the other examined reference texts. The Richardson system did not detect the interaction; the *PILLS* system stated that it was a "Possible" interaction (ie. of low significance); Park Systems' program rated the interaction as level "2" (ie. of moderate significance; yet the AAH *LINK* system rated this as a "three-star" interaction. This is an example of how a well-documented interaction can either be overlooked, or interpreted in a number of different ways by the program suppliers.

A second example of this type of problem is the interaction between diltiazem and aminophylline. Stockley[59] states that this drug combination can be used safely despite a 12-21% decrease in theophylline clearance after the administration of diltiazem; however references cited in EDI show that the mechanism of this interaction is very unclear.[109] The interaction between theophylline and diltiazem is shown as potentially hazardous in the BNF. Therefore the secondary literature reference sources for this interaction are somewhat inconsistent. Consequently, it is not surprising that the computer systems were inconsistent in the reporting of the interaction between diltiazem and aminophylline. The Richardson system did not report any interaction, possibly as a result of Stockley's advice. The AAH *LINK* system ranked this a "three-star" interaction; Park Systems a level "1" interaction (ie. major); *Alchemist 3000* a moderate interaction; and *PILLS* a "Probable" interaction, reflecting the BNF.

8.4.7 How Could Drug Interaction Reporting by Pharmacy Computer Systems be Improved?

The examples of reported interactions, in Appendix 4, show many inconsistencies both between published reference sources and reports from pharmacy computer systems. It is quite possible that a pharmacist could use two sources, eg. *Drug Interactions*[59] and the Richardson computer system, and not be alerted to an interaction using either; yet another pharmacist using two different sources, for example the BNF and the *PILLS* system, may detect interactions using both. This is what would happen in the case of

diltiazem and aminophylline. Where there are conflicting reports in the literature, there will always be the potential for inconsistencies between computer programs. However where this is the case, the software should be programmed to indicate any divergence of opinion as to the importance of any particular interaction to the user, better enabling him to obtain the optimal patient outcome.

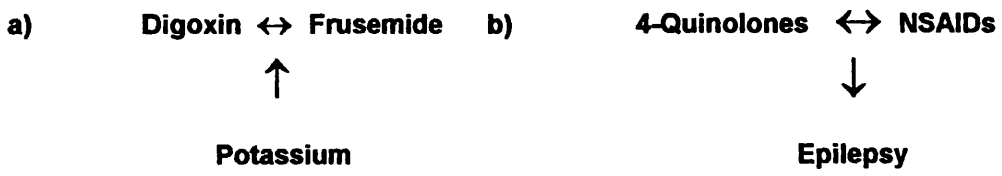
Most UK pharmacy computer systems, unlike some used in the USA, provide users with very little referenced information about drug interactions (Table 6.3). A fuller explanation of potential interactions, and citation of key references, would probably be of benefit to users and patients under their care.

During the clinical intervention survey (Chapter 7), some respondents stated that GPs occasionally refused to alter patients' therapy when confronted with alleged drug interactions, due to differences in the perceived importance of those interactions by pharmacist and doctor. Community pharmacists' use of computer systems to monitor for potential drug interactions has been shown to be higher than GPs' use.[26,131,132] It would surely be of benefit to patients if the pharmaceutical and medical professions agreed on common reference sources for drug interactions. Partly with this in mind a survey of GPs' use of interaction reference sources has been conducted; the results are presented in Section 9.3.

8.4.8 "Ternary Systems"

All of the interactions shown in Appendix 4 can be considered as "binary" interactions, involving two interacting drugs. The author proposes the development in pharmaceutical and medical computer systems of what would be called "ternary systems." Models illustrating ternary interactions are shown in Figure 8.4.

Figure 8.4: Software models for the proposed "ternary system" drug-interactions.



As part of the clinical intervention survey (Chapter 7), an interaction between loop diuretics and digoxin was reported. When the pharmacist further investigated this, it was found that the patient concerned was also taking a potassium supplement, thus reducing the concern about the interaction (Section 7.4.1.7). This is an example where drug interaction software cannot, at present, process more than two drugs at any one time.

Drug interaction monitoring software that detects the likelihood of adverse drug interactions in those sub-population as particular risk have not yet been detected.[141] Rarely, 4-quinolone antibiotics, for example ciprofloxacin may precipitate seizures in epileptic patients: the probability of this adverse drug reaction is increased if NSAIDs are administered concurrently.[173] This is an example of where a patient's clinical condition may determine the validity of a potential drug interaction. These two examples show the need for enhanced drug interaction monitoring software, capable of processing more than two factors at any one time. The use of decision-making and support packages using "expert system" software is likely to facilitate this at some point in the future. Expert systems are described as computer systems that are capable of performing at or near to the levels of an expert in a particular field.[174] Although not yet used in pharmacy practice, expert systems have been used in medicine.[175-177]

8.5 Conclusions and Recommendations

1. This analysis of nearly 200 potential drug interactions, using five drug interaction monitoring programs, has shown that there is considerable inconsistency between the systems in their ability to detect drug interactions. This lack of consistent performance can be due to several factors: consideration of general pharmaceutical classes of compounds as opposed to individual drug entities; frank programming omissions; incomplete or out-of-date drug files; and lack of consideration of pharmaceutical form and route of administration.

2. Internal audit of the drug databases by the software supplier concerned, together with external audit by appropriate experts would help to eliminate non-complex errors within the product files, for example due to typing mistakes.

3. Complex interaction problems, involving three or more drugs will require the use of more advanced software, possibly using "expert system" techniques, to enhance patient outcome.

9. General Medical Practitioners' Views on Patient Medication Records in Community Pharmacy

A survey has been conducted to examine general practitioners' (GPs) views on community pharmacists' use of PMR systems. In particular, opinions were solicited on whether pharmacists should maintain PMRs, and if so, for which patient groups. Community pharmacists' use of patient information leaflets has been described in Chapter 5 and in this survey GPs were asked whether they approved of pharmacists issuing *PILLS* type patient information leaflets to patients, and whether they considered that the use of such leaflets affected patient compliance.

Problems associated with the use of drug interaction monitoring software, and discrepancies between literature-based and computer-based reference sources have been described in Chapter 8. The study presented in this chapter has examined GPs' use of available reference sources on drug interactions, and whether they welcome information from community pharmacists on potential drug interactions arising from prescribed medication.

9.1 Introduction

9.1.1 General Practitioners' Use of Computer Systems

GPs have been encouraged by Government to use computer systems since the early 1980's. In June 1982 the "Micros for GPs" scheme was announced by the Department of Industry, now the Department of Trade and Industry.[178] This scheme helped 150 general practices to install computers designed for the registration of patients, the issue of repeat prescriptions and the screening and recall of patients. The final report on the scheme identified that the main benefits of computers in general medical practice were not in the day-to-day routine of practice administration, but rather in the aggregation and analysis of information.

Further financial support for GPs' use of computer systems came from the pharmaceutical industry during the mid-1980's.[30] Ciba-Geigy provided subsidised software to GPs in 1986, and systems were provided to GPs at no cost by VAMP and AAH Meditel in 1986, in exchange for the return of prescribing data, which could then be traded to marketing organisations and the pharmaceutical industry. The VAMP and AAH Meditel schemes ceased in 1991 due to lower than expected financial returns from the data collected by these two organisations.[179]

In 1987 the Government White Paper *Promoting Better Health* made direct reference to the benefits of practice computers[23], as did the White Paper *Working for Patients* in 1989.[180] In contrast, apart from payments for the maintenance of PMRs, community pharmacists have received no financial support from Government or the pharmaceutical industry towards the capital and running costs of computer systems.

Since April 1991, GPs have been able to elect to become "fund-holders", whereby they control their own financial budgets enabling them to "buy" services for their patients. The survey reported here examines whether being a fund-holder influenced GPs' use of computer systems or their attitudes towards community pharmacists' use of systems. Similarly the attitudes of dispensing doctors (Section 1.2) have been examined, as have the influences of the location in which a GP practises and his year of registration as a doctor. In our earlier study, community pharmacist's year of registration has been shown to influence PMR use and attitudes towards PMR systems (Section 2.4.4), whereas pharmacy location had no significant influence (Section 2.4.7).

It was thought that more-recently registered GPs would be more positive in their attitudes towards the community pharmacist's clinical role, given that their postgraduate clinical training will have involved exposure to clinical pharmacy in the hospital setting. It was felt that the location in which a GP practises could influence attitudes towards the clinical role of the community pharmacist. There are two

possible reasons for this: first, rural GPs are more likely to dispense medicines than their non-rural colleagues, which can lead to generally poor working relationships or disputes between community pharmacists and dispensing doctors[181]; second, from the author's management of four pharmacies and experience in several others, relationships between the general practitioner and community pharmacist tended to be better in small to medium-sized towns than in suburban or city centre locations.

9.1.2 General Practitioners' Perceptions of the Community Pharmacist's Clinical Role

Professional relationships between GPs and community pharmacists have been discussed in the Nuffield Report, which stated that the co-operation shown between hospital practitioners was rarely reflected in the community.[1] The report then progressed to state how the development of closer relationships between GPs and community pharmacists would be in the interests of patients and could lead to a more efficient use of resources within the NHS.

In a recent paper (1992), Spencer and Edwards described the results of a survey of general practitioners' attitudes to the community pharmacist's extended role.[182] High levels of support were found among GPs for an increased role for community pharmacists in three areas: managing minor illness, advising general practitioners about cost effective prescribing, and reporting adverse drug reactions. There was little support found among GPs for pharmacists' involvement in screening for raised blood pressure and blood lipid levels. Support for pharmacists supervising repeat prescriptions was mixed. Spencer and Edwards felt that at a local level relationships between the professions were good, though closer co-operation and better communication might help to extend the quality of advice given to patients.

In New Zealand in 1991, Ellis *et al* conducted a survey on general practitioners' views of the community pharmacist.[183] High support was found among GPs for the community pharmacist's traditional roles of dispensing and providing advice to patients on minor illnesses. Respondents also felt that it was appropriate for community pharmacists to advise medical practitioners on drug usage and information. However, they did not welcome the provision to patients of information about previously diagnosed conditions. In this context it should be noted that the Hadley Hutt *PILLS* system used in the UK (Section 5.1.3) can provide information leaflets on several clinical conditions.

Blenkinsopp *et al* have described development of liaison groups between GPs and community pharmacists as a novel way of facilitating communication between the two professions serving the same patient cohort.[184] As part of their study, two research groups have been set up to examine the feasibility of collaboration between GPs and community pharmacists in monitoring patients suffering from asthma.

In the survey described here, the aim was to make both quantitative and qualitative assessments about GPs' opinions on the community pharmacist's role in maintaining PMRs, together with the associated roles of providing patient information leaflets and advising prescribers on potential drug interactions.

9.2 Method

9.2.1 Equipment and Materials Used

Questionnaire forms and other project documents were produced using Microsoft Word for Windows on a Viglen Genie IBM compatible computer and a Hewlett-Packard DeskJet 500 printer. SPSS/PC+ V4.0 was used to record results from returned questionnaires and for statistical analysis of the data. A Freepost licence arrangement with the Post Office facilitated the return of questionnaires.

9.2.2 Design of Questionnaire

This survey considered those factors that could possibly influence a GP's attitudes towards pharmacists' involvement in maintaining medication records. These were envisaged to include the location of the GP's workplace; whether he was a fund-holder; the GP's length of experience, represented by his year of registration as a doctor; whether he belonged to a dispensing practice; and the degree to which he used a computer system for clinical purposes.

A questionnaire was developed to gather responses from GPs as to whom they thought should hold patients' medication records; which patient groups pharmacists should maintain records for; whether pharmacists should include clinical conditions in PMRs; whether pharmacists should provide information to patients using computer-generated information leaflets; to what extent pharmacists' advice on drug interactions was welcome; and those reference sources which a GP used if he suspected the existence of a potential drug interaction.

The questionnaire was piloted among a sample of 20 GPs in the [3]Guildford area, and their comments were taken into account in making minor changes to the questionnaire; in particular the length of some questions was reduced and the typeface was altered to produce a final questionnaire printed on fewer pages.

A covering letter, a copy of the final questionnaire (Appendix 2, page 333) and the *PILLS* leaflet on penicillins were sent to a total of 1257 GPs (579 in Avon, 678 in Devon) in April 1993. A Freepost envelope was enclosed for the return of the completed questionnaires. Non-respondents were sent a reminder and a second copy of the questionnaire after a six week period.

---

[3]Guidford was chosen as it was an area that would not be included in the final survey. Also, the author was familiar with this location, and was aware that the sample would be likely to contain a representative mixture of GPs, including some who provided a dispensing service for their patients.

9.3 Results

Completed questionnaires were received from 811 GPs (383 from Avon, 423 from Devon, and five unidentifiable due to their identity codes being obliterated by the respondents). Information was also provided that two GPs were on long term sickness leave; two were on sabbatical; two had relocated; and three only provided a family planning service. Another GP wrote a letter detailing his considered reasons for not responding to the questionnaire. An overall response of 64.5% was therefore achieved; the response from Avon (66.1%) being slightly higher than that from Devon (62.4%). A profile of the respondents is shown in Table 9.1.

763 (94.1%) of the respondents worked in a computerised practice. GPs use of computer systems is shown in Table 9.2.

The responses in Table 9.2 were cross-tabulated with the practice profile data from Table 9.1, and analysed using the χ^2 test of independence.[63,64] City centre practitioners were shown to be less likely to work in computerised practices than those elsewhere (χ^2=18.3, df=4, p<0.01); 87.7% of GPs working in city centre areas were in computerised practices. A computer system was used by 98.9% of fund-holding GPs, in contrast to 92.6% of non-fund-holders (χ^2=10.6, df=1, p<0.01). Fund-holding GPs were also more likely to use their computer system to monitor for potential drug interactions than non-fund-holders (57.1% of fund-holders, 47.0% of non-fund-holders, χ^2=5.82, df=1, p<0.05); and to use their systems to view clinical data on patients (82.0% of fund-holders, 71.0% of non-fund-holders) (χ^2=8.92, df=1, p<0.01). Finally, 59.2% of fund-holders possessed a modem and communications software, compared with 39.4% of non-fund-holders (χ^2=22.1, df=1, p<0.0001).

Table 9.1: General medical practitioner practice profiles.

		FHSA:			
		Avon	*Devon*	*Not identified*	*Total*
Practice location:	City centre	70 (18.5%)	58 (13.9%)	2	130 (16.2%)
	Suburban	164 (43.3%)	73 (17.5%)	2	239 (29.8%)
	Small town	88 (23.2%)	188 (45.0%)		276 (34.4%)
	Rural	34 (9.0%)	80 (19.1%)	1	115 (14.3%)
	Other	23 (6.1%)	19 (4.5%)		42 (5.2%)
Fund-holder:	Yes	87 (22.7%)	102 (24.2%)	1	190 (23.5%)
	No	296 (77.3%)	319 (75.8%)	4	619 (76.3%)
Dispensing practice:	Yes	36 (9.4%)	77 (18.3%)	1	114 (14.1%)
	No	346 (90.6%)	343 (81.7%)	4	693 (85.9%)
Year of registration:	1962 or earlier	41 (10.8%)	56 (13.2%)		97 (12.0%)
	1963-72	116 (30.4%)	109 (25.8%)	2	227 (28.1%)
	1973-82	168 (44.1%)	179 (42.3%)	3	350 (43.3%)
	1983-92	56 (14.7%)	79 (18.7%)		135 (16.7%)

Cross-tabulation of the responses, followed by χ^2 analysis showed that rural GPs were less likely to be fund-holders than those GPs practising elsewhere (χ^2=25.9, df=4, p<0.0001). 51.3% of those GPs classed as "rural" were dispensing doctors, this differed significantly from all other practice locations (χ^2=181.1, df=4, p<0.0001).

Table 9.2: General practitioners' use of computer systems.

		FHSA:			
		Avon	*Devon*	*Not identified*	*Total*
Computerised practice:	Yes	363 (94.8%)	395 (93.4%)	5	763 (94.1%)
	No	20 (5.2%)	28 (6.6%)		48 (5.9%)
Use of computer system to	Yes	187 (51.7%)	187 (47.5%)	3	377 (49.5%)
monitor for drug interactions:	No	175 (48.3%)	207 (52.5%)	2	384 (50.5%)
Use of computer system to	Yes	263 (72.7%)	296 (74.7%)	4	563 (73.8%)
view clinical patient data:	No	99 (27.3%)	100 (25.3%)	1	200 (26.2%)
Use of computer system to	Yes	232 (63.9%)	251 (63.7%)	5	488 (64.0%)
view clinical drug data:	No	131 (36.1%)	143 (36.3%)		274 (36.0%)
Possession of modem and	Yes	167 (47.2%)	162 (41.8%)	3	332 (44.4%)
communications software:	No	187 (52.8%)	226 (58.2%)	2	415 (55.6%)

Dispensing doctors were more likely to use their computer systems to monitor for potential drug interactions (68.5% dispensing doctors, 46.2% non-dispensing doctors) (χ^2=18.4, df=1, p<0.0001); and to possess a modem and communications software (61.9% dispensing doctors, 41.5% non-dispensing doctors) (χ^2=15.3, df=1, p<0.0001).

GPs who registered before 1962 were less likely to work in a computerised practice than their more-recently registered colleagues (χ^2=15.0, df=3, p<0.01).

GPs' responses to the question "Who do you think should keep patients' medication records?" are shown in Table 9.3.

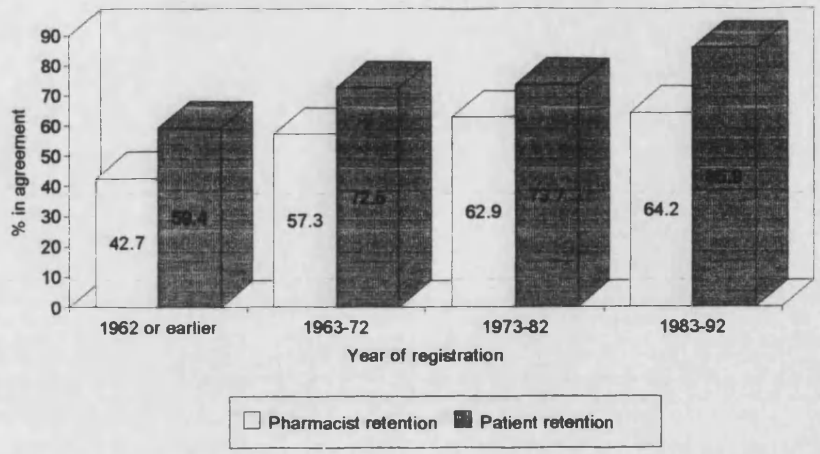
Table 9.3: General practitioners' responses to the question "Who do you think should keep patients' medication records?"

Prescribers	738 (91.6%)
Patients	593 (73.7%)
Pharmacists	474 (59.1%)
FHSAs	35 (4.3%)
Others	29 (3.6%)

Twenty nine respondents indicated that other persons or groups should hold patients' medication records. Where specified, these included carers, hospitals, nursing and residential homes, and the ambulance service. The only significant factor influencing respondents' views on PMR retention was whether the GP was a dispensing doctor Only 42.9% of dispensing doctors stated that pharmacists should hold PMRs, in contrast with 61.7% of non-dispensing doctors (χ^2=14.1, df=1, p<0.001).

Significant trends were shown in the effect of the GPs' year of registration on their views of whether patients (p<0.001) and pharmacists (p<0.01) should hold PMRs. This is illustrated in Figure 9.1.

Figure 9.1: The effect of GPs' year of registration on their opinion whether patients and pharmacists should retain patient medication records.



The next question (Q9) on the questionnaire presented the hypothetical situation where the FHSA, or some other authority, held patient records; GPs were asked which professional groups should have access, appropriate to their role, to patient records. Responses to this question are shown in Table 9.4.

Table 9.4: GPs' agreement with selective access to FHSA-held records by primary health care professions.

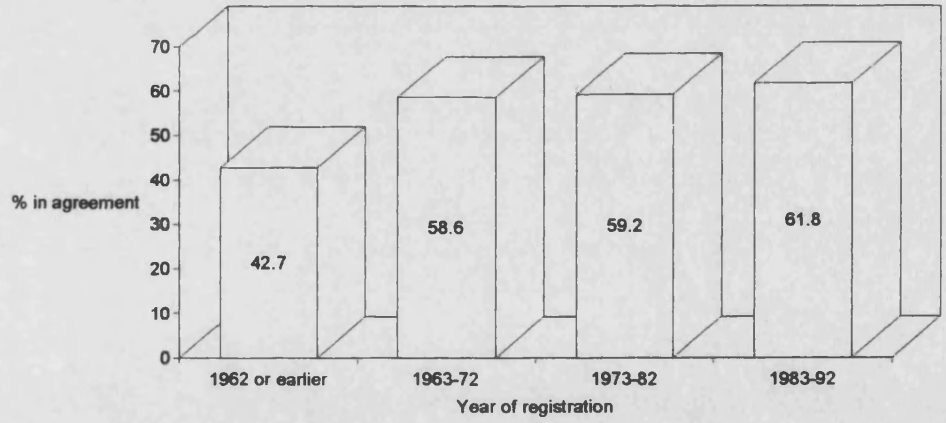
GPs	732 (92.3%)
Pharmacists	455 (57.4%)
Dentists	416 (52.4%)
Opticians	253 (31.9%)
Others	46 (5.8%)

Of those 46 respondents stating that "Others" should have selective access to FHSA-held patient records, ten stated hospital doctors, five community nurses, three chiropodists, three hospital pharmacists, two the ambulance service, and one physiotherapists. Nine respondents explicitly stated that the FHSA should not hold patient records under any circumstances. Reasons given were lack of security and confidentiality and that it was not the role of the FHSA to keep such patient data.

Only 42.0% of rural GPs felt that pharmacists should have selective access to patient records, in contrast with 61% of GPs in city centre, suburban and small town locations, (χ^2=19.4, df=4, p<0.001). This finding matched the views of dispensing doctors; of whom 45.9% were in favour of pharmacists having selective access to patient records, in contrast with 59.5% of non-dispensing doctors (χ^2=7.2, df=1, p<0.01). Dispensing doctors (23.4% were in favour) were also less likely than non-dispensing doctors (33.4% were in favour) to accept that ophthalmic opticians should have access to FHSA-held patient data (χ^2=4.35, df=1, p<0.05).

GPs who registered before 1962 were less likely than their more-recently registered colleagues to agree with pharmacists having selective access to FHSA-held patient records. This is illustrated in Figure 9.2.

Figure 9.2: The effect of year of registration on whether GPs considered community pharmacists should have selective access to FHSA-held patient records.



Patient registration with a pharmacy was considered beneficial for all patients by 115 respondents (14.4%), compared with 574 (72.1%) who supported this for selected patient groups. Registration with a pharmacy was considered of no benefit to any patients by 107 (13.4%) respondents. A greater diversity of opinion occurred with GPs from Devon, and those practising in rural areas. These groups tended to show

greater preferences either for registration of all patients, or no patient registration at all. Dispensing and non-dispensing doctors did not differ significantly in their views. Five respondents expressed concern that any registration scheme would have to have adequate provisions for rota duties and emergency dispensing.

GPs were presented with a list of candidate groups of patients with clinical disorders, and asked to state whether they agreed that pharmacists should keep medication records for these patients. Responses are shown in Table 9.5.

Table 9.5: GPs' agreement with pharmacists keeping PMRs for selected patient groups.

Confused patients	689 (85.8%)
Elderly	640 (79.7%)
Patients having experienced drug allergies or major adverse reactions	628 (78.3%)
Diabetics	611 (76.1%)
Asthmatics	562 (70.1%)
Epileptics	543 (67.5%)
Patients with renal or hepatic impairment	513 (64.0%)
Ostomy patients	440 (54.8%)
Patients with cardiac disorders and/or hypertension	430 (53.0%)
Patients with a history of peptic ulceration	342 (42.6%)
HIV positive / AIDS patients	240 (30.0%)

GPs in Avon (26.3%) appeared to be less likely than those from Devon (33.3%) to favour pharmacists keeping records for HIV positive / AIDS patients, (χ^2=4.6, df=1, $p<0.05$), although the FHSA in which respondents practised did not influence the agreement with pharmacists keeping PMRs for any other patient groups. GPs practising in rural areas were less likely than their colleagues practising elsewhere to favour pharmacists keeping PMRs for the following patient groups: epileptics ($p<0.01$); the confused, the elderly, diabetics, asthmatics, those with a history of ADR, and those patients with renal or hepatic failure (all $p<0.05$). Similarly, dispensing doctors were less likely than their non-dispensing colleagues to favour pharmacists

keeping PMRs for the following patient groups: diabetics, epileptics and those with cardiac disorders and/or hypertension (all $p<0.01$); the elderly, asthmatics, and those patients with renal or hepatic failure (all $p<0.05$).

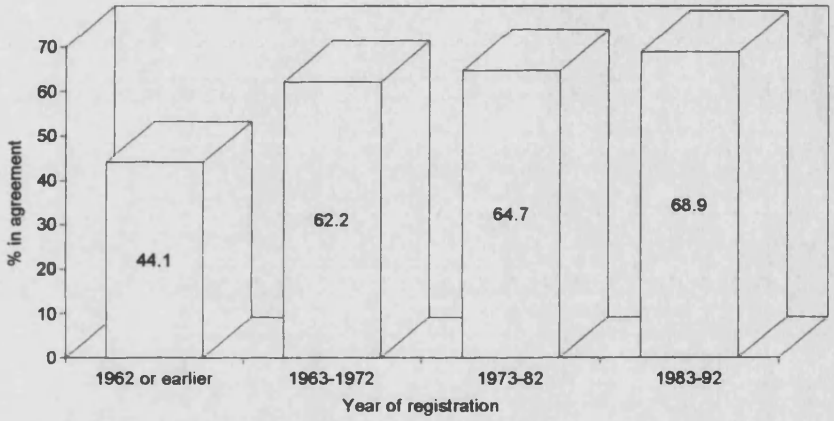
42 respondents listed other patient groups that they believed should be included in pharmacists PMRs (Table 9.6).

Table 9.6: Other patient groups for whom GPs believed pharmacists should keep medication records.

	Number of cases:
Drug mis-users	24
All those on multiple medication	12
Those on anti-coagulants	11
Long term mentally ill	8
Those on steroids	5
Those on benzodiazepines	5
Handicapped / blind	3
Patients with allergic conditions	3
Pregnant women	3
Skin disorders	2
Those on anti-depressants	2
Any condition requiring frequent changes of medication	1
Carcinoma patients	1
Coeliacs	1
Immuno-suppressed patients	1
Nursing mothers	1
Patients on azathioprine	1
Patients on lithium	1
Patients with gastro-intestinal disorders	1
Residential / nursing home patients	1
Rheumatology patients	1
Temporary residents	1
Those taking HRT or oral contraceptives	1

A majority of respondents (454, 57.6%) were in agreement with pharmacists including patients' clinical conditions within PMRs. However, dispensing doctors (48.2%) were less likely to favour the recording of clinical conditions than non-dispensing doctors (58.9%), (χ^2=4.47, df=1, p<0.05). The GPs' year of registration as a doctor also influenced opinions on whether clinical conditions should be encompassed within PMRs (χ^2=8.51, df=3, p<0.05), with more-recently registered GPs favouring the inclusion of clinical conditions. This is illustrated in Figure 9.3.

Figure 9.3: The effect of GPs' year of registration on agreement with the inclusion of clinical conditions in PMRs.



Three GPs expressed specific concerns about the recording of clinical conditions within PMR systems. One was concerned about breaches of confidentiality; another felt that conditions should be recorded within GPs' computer systems, but not within pharmacists' systems; the third felt that large multiple pharmacy groups would be able to afford better systems than independent pharmacies.

Those respondents who agreed with the inclusion of patients' clinical conditions within PMR systems were then asked a further question on how such clinical details should be incorporated. The responses to this question are shown in Table 9.7. None of the practice parameters from Table 9.1 influenced respondents' opinions on the recording of patients' clinical conditions.

Table 9.7: GPs' opinions on how pharmacists should incorporate patients' clinical conditions within PMR systems. The figures give numbers of respondents (and percentage of total) agreeing with each listed method.

By inference, using patients' medication profiles	39 (8.8%)
Asking patients, using a confidential questionnaire form	137 (30.9%)
Through formal contact with GP and/or practice staff, with assurance of confidentiality	176 (39.6%)
A combination of any of the above	84 (16.9%)
Some other method	8 (1.8%)
Total:	444 (100%)

Of the 454 respondents who agreed with pharmacists' including clinical conditions within PMRs, 10 did not indicate how they considered this should be achieved. Eight GPs stated that some other method of including clinical conditions was preferable; of these, four respondents (all from Devon) stated that the use of smart cards (Section 1.5.1) was the most appropriate method. One further respondent stated that computer systems used by pharmacists and GPs should be linked (Section 1.5.2). A suggestion was made, by one GP, that prescriptions should indicate the condition for which a product was prescribed, especially for chronic conditions.

Table 9.8: GPs opinions on whether pharmacists should provide *PILLS* type patient information leaflets

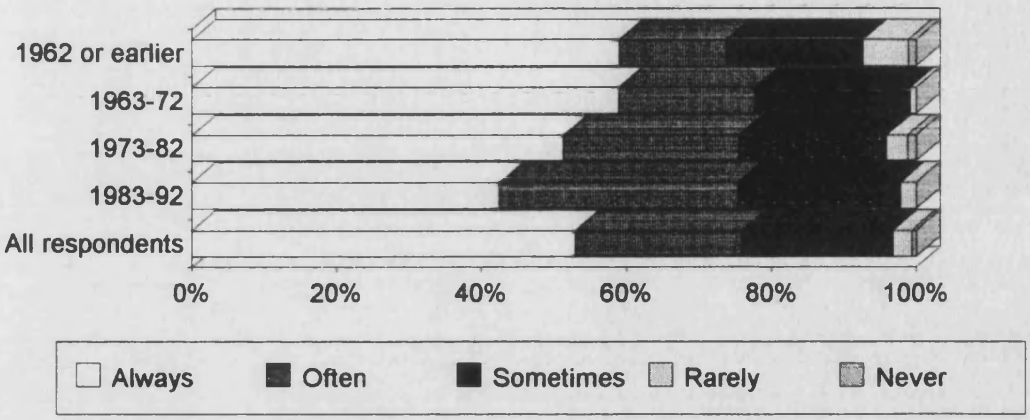
	In favour of leaflets	*Not in favour of leaflets*	*Statistics*
All GPs:	623 (79.9%)	157 (20.1%)	
GPs in Avon	304 (83.5%)	60 (16.5%)	$\chi 2=5.3$, df=1, $p<0.05$
GPs in Devon	316 (76.9%)	95 (23.1%)	
GPs registering before 1963	67 (72.8%)	25 (27.2%)	
GPs registering between 1963-72	167 (76.6%)	51 (23.4%)	$\chi 2=18.4$, df=3, $p<0.001$
GPs registering between 1973-82	267 (78.8%)	72 (21.2%)	
GPs registering between 1983-92	120 (93.0%)	9 (7.0%)	

GPs were presented with a Hadley Hutt *PILLS* leaflet on penicillins and asked to state whether they considered that pharmacists should provide such information leaflets to patients. Furthermore, the questionnaire solicited respondents' opinions on their perceptions as to the effect of such leaflets on patient compliance. GPs' opinions on the provision of leaflets are shown in Table 9.8. The question about whether pharmacists' use of patient information leaflets would influence compliance was answered by 770 respondents, of whom, 373 (48.4%) believed that the use of leaflets would improve compliance, 33 (4.3%) stated that the use of leaflets would have no effect on compliance, 118 (15.3%) believed that pharmacists' use of leaflets would worsen compliance, 246 (31.9%) were unsure of the effects of leaflets. Additional comments by certain GPs were largely critical; these are discussed in Section 9.4.8.

The next series of questions in the questionnaire concerned the recording of non-prescribed medication within PMRs. 229 (29.1% of those responding) felt that pharmacists should record the sale of all non-prescription medicines. A further 116 (14.7% of those responding) felt that pharmacists should record the sale of those medicines recently transferred from prescription-only to pharmacy-sales status, for example hydrocortisone 1% cream and clotrimazole pessaries. Relatively few GPs (119, 15.2% of those responding) felt that pharmacists should keep records of the supply of non-prescription medicines for all patients. This figure rose to 308 (39.2% of those responding) in agreement with record keeping for certain patient groups only; this particular figure was influenced by the GP's year of registration. Those registering in 1973 or later were more likely to favour (43.6%) a selective form of record retention for non-prescribed medicines than those doctors qualifying in 1972 or earlier (32.6%), (χ^2=13.1, df=3, p<001). Finally, 206 (26.2% of those responding) stated that the recording of the supply of non-prescription medicines should not be a role for the community pharmacist.

GPs' responses to how often they welcomed information from community pharmacists about potential drug interactions is shown in Figure 9.4.

Figure 9.4: How often GPs welcome information about potential drug interactions from pharmacists.



The only parameter which appeared to have any influence on GPs' attitudes to pharmacists providing them with warnings about potential drug interactions was the year of registration. This is discussed in Section 9.4.7.

GPs were then asked to state those reference sources that they would normally use if they suspected a potential drug interaction. Their responses are shown in Table 9.9.

Of the 23 respondents who stated that they use reference sources other than those listed in the questionnaire, four cited Beeley's pamphlets *Safer Prescribing*[186], four cited Martindale (Section 8.1.3.2)[133], and two cited drug companies. One cited Professor Inman in Southampton, one a clinical pharmacologist, one a local hospital consultant, and another his practice colleagues.

Table 9.9: GPs' normal reference sources when dealing with a potential drug interaction.

	No. using source (% of total respondents)
BNF[81]	743 (92.2%)
ABPI Data Sheet Compendium[169]	417 (51.7%)
Their practice computer system	235 (29.2%)
Hospital pharmacy / district drug information centre	198 (24.6%)
MIMS[138]	191 (23.7%)
Local community pharmacist	135 (16.7%)
Regional drug information centre	79 (9.8%)
Drug Interactions[59]	52 (6.5%)

Some interesting findings were obtained by performing cross-tabulations between the reference sources in Table 9.9 and the practice parameters in Table 9.1, followed by a χ^2 test of independence.[63,64] Stockley's book[59] was used by 8.3% of the respondents from Devon compared with 4.5% from Avon, (χ^2=4.8, df=1, $p<0.05$). 38.3% of fund-holders used their practice computer system for monitoring for potential drug interactions compared with 26.5% of the non-fund-holders, (χ^2=9.8, df=1, $p<0.01$).

A number of trends were observed with GPs' year of registration. These are shown in Table 9.10. Differences between dispensing and non-dispensing doctors are shown in Table 9.11.

Table 9.10: The influence of GP's year of registration on their use of sources of information when dealing with potential drug interactions. (Percentage using stated source shown)

	Year of registration				
	1962 or earlier	1963-72	1973--82	1983-92	Statistics df=3
MIMS[138]	34.4	34.4	19.1	10.4	χ^2=37.1, p<0.0001
ABPI Data Sheet Compendium	57.3	63.8	49.1	34.3	χ^2=31.4, p<0.0001
BNF	87.5	89.7	92.9	97.8	χ^2=10.8, p<0.05
Local community pharmacist	26.0	17.9	13.7	16.4	χ^2=8.4, p<0.05

Table 9.11: Differences between dispensing and non-dispensing doctors on the use of sources of information when dealing with potential drug interactions. (Percentage using stated source shown)

	Dispensing doctors	Non-dispensing doctors	Statistics df=1
ABPI Data Sheet Compendium	63.7	49.8	χ^2=7.5, p<0.01
Hospital pharmacy / district drug information centre	32.7	23.4	χ^2=4.6, p<0.05
Their practice computer system	37.2	27.9	χ^2=4.1, p<0.05
Local community pharmacist	9.7	18.0	χ^2=4.7, p<0.05

In reply to a specific question the BNF was regarded as the standard reference source by 759 GPs (95.8% of those responding). Of the 33 respondents who did not agree that the BNF should be taken as the standard reference source on drug interactions, 15 stated that the ABPI Data Sheet Compendium should be standard, three each stated

regional and district hospital drug information, two stated Stockley's book[59] (one with the condition that it should be updated quarterly), and two stated the need for regular drug information updates in suitable electronic form.

9.4 Discussion

The response to the questionnaire used in this survey was slightly lower than the surveys described in Chapters 2, 3 and 4, which were conducted with community pharmacists. However, the response of 64.5% was not dissimilar to a survey ascertaining GPs' attitudes to an extended role for community pharmacists, which attained a response of 68.4%.[182]

9.4.1 General Practitioners' Computer Use

In this survey, 94.1% of the respondents stated that they worked in a computerised practice. This figure is higher than two surveys published in 1991. Goves *et al* estimated that 67% of all patients in Wales were served by a computerised practice.[131] Rogers and Fletcher showed by means of a survey of GPs practising in Bath and Bristol, that 84% worked in a computerised practice.[132] The new NHS contract for GPs allows them to receive bonus payments for achieving targets in patient monitoring (for example blood pressure) and immunisation. Greater use of computer systems to store patient data is likely to assist GPs to achieve such targets.

Use of the various features available in general practice computer systems has increased since 1991, although it appears that these systems are still not being used to their full potential (Table 9.2) The recording of patients' clinical details has not altered significantly over the last two years: 73.8% of respondents in this survey used their system to view patients' clinical records, compared with 76%[131] and 65%[132] in the earlier studies. The number of practices possessing a modem has increased considerably. In 1991, only 9.1% of those practices sampled by Goves *et al* had a modem[131]; in the present study 44.4% of the sample of GPs worked in a practice that had a modem.

There was low usage of computer systems to monitor routinely for potential drug interactions between prescribed medicines: 20% in our 1991 survey[132] and 49.5% in this survey. Only 29.2% of the respondents stated that th y would use their computer system to check a suspected drug interaction (Table 9.9) The reasons for this low reported use are not clear, although some GPs expressed irritation with information provided by their computer systems. One GP complained that interaction information provided by his system was not sufficiently drug-specific, a problem that has been discussed in Section 8.1.4. Another GP was irritated by repetitive warnings being issued by his system.

A further reason for the apparent low use by GPs of their drug interaction monitoring software is possibly that the use of computerised systems for drug interaction monitoring is viewed as a "dispensing" function. Support for this may be offered by the fact that dispensing doctors were more likely to use their computer system in monitoring for potential drug interactions than non-dispensing doctors.

9.4.2 Fund-Holding GPs

It is noteworthy that fund-holding GPs were shown to be more likely than non-fund-holding GPs to possess and make greater use of their computer systems, through monitoring for potential drug interactions, viewing clinical data on patients and use of a modem.

9.4.3 Retention of Patient Data

GPs traditionally have maintained patients' medical records, and so it is not surprising that a large majority of the respondents stated that prescribers should keep patients' medication records (Table 9.3). The figure of 91.6% takes into account a small number of GPs who felt that only they, and not dentists (who are also prescribers) should keep patients' medication records. The high number of respondents (73.7%)

expressing the opinion that patients should have responsibility for retaining their own records included one who pointed out that many patients effectively retain a medication record by means of a repeat prescription card. However, relying on this alone will not usually permit the recording of "one-off" prescription items, for example short courses of antibiotics for acute infections, nor non-prescription medicines. One respondent from a Devon coastal resort commented that "patients should be encouraged to record prescribed and OTC products on hand-held records." This respondent emphasised the benefit of this method for holidaymakers. This group of patients are likely to present at pharmacies, requesting emergency supplies of prescription-only medicines; present at GPs' surgeries in need of primary medical care; and also present in hospital as a casualty patient or an emergency admission. In all of these circumstances, some form of patient-held medication record would be useful for a rapid assessment of the patient's medication profile.

A majority (59.1%) of respondents felt that pharmacists should keep PMRs. A similar percentage of respondents (57.4%) stated that community pharmacists should have selective access to FHSA-held records. However, it is of concern that over 40% of respondents appeared not to recognise a role for community pharmacists in maintaining medication records or having access to patients' medication details. Reasons for this may include an incomplete knowledge of the pharmacist's education and training, a lack of appreciation of what the community pharmacist actually does, and fear of community pharmacists extending their role. Comments from the returned questionnaires that may support this limited appreciation were:

i) "Pharmacists require a very much increased clinical knowledge."

ii) "As far as I am concerned, the role of the pharmacist is in dispensing only, which includes checking for drug interactions and warning of side effects. I

worry about attempts to extend the pharmacist's role into other areas as they are not trained in diagnosis."

Another possibility is that GPs are not convinced of the benefits to patients of pharmacy-held PMRs. This view is perhaps valid since there has been little published work in the UK to demonstrate the benefits of PMRs to patients and the NHS. In particular, there have been no published reports extending work to include patient outcome. One GP stated "any system must demonstrate definite benefits and not generate extra paperwork." Four GPs commented that pharmacy PMRs would create "unnecessary duplication" of data. Such views are likely to persist until such a time when the value to patients of community pharmacists' clinical interventions have been more widely demonstrated.

Some of the general comments on pharmacists' use of PMRs were positive. One GP stated that pharmacists should have access, via computer-link, to *all* patient records. Two further respondents commented that pharmacist-maintained PMRs could be used to facilitate a system of repeat dispensing by community pharmacists, whereby patients could have medication dispensed monthly by the pharmacist, returning to the GP every six months for clinical review.

Concerns about data security and the confidentiality of patient records were expressed by GPs in response to several of the survey's questions. The main reason put forward for not having FHSAs store patient data was a potential lack of security. The following comment from one GP was typical:

"I am very worried about patient confidentiality in general - and particularly in connection with HIV/AIDS - what are the statutory requirements of pharmacists in this respect - I do not know."

9.4.4 Family Health Services Authorities

The greatest number of GPs in Avon were working in suburban practices (Table 9.1), whereas the greatest number of Devon GPs were working in practices located in small towns. A higher number of GPs in Devon were working in rural practices than their colleagues in Avon. The majority of those practices that were classified as rural, were also dispensing practices in both FHSAs. Despite these differences in the profiles of GPs practising in Avon and Devon, only three differences were found between these two samples of GPs. Given the relatively weak statistical inferences in each case ($0.01<p<0.05$), these findings may be valid or could be statistical artefacts. Firstly, GPs in Avon were less likely to favour pharmacists keeping records for HIV positive/AIDS patients. This may be due to GPs' greater awareness of the possible incidence of HIV infection among drug abusers in the Bristol area. Secondly, GPs in Devon were less in favour than their colleagues from Avon of pharmacists issuing computer-generated patient information leaflets (Table 9.8). This may be accounted for at least partly by the considerable opposition of a number of GPs in Plymouth to the use of *PILLS* leaflets by a small multiple pharmacy group (Personal communication). Thirdly, a greater number of Devon GPs stated that they would refer to Stockley's text on drug interactions[59] than would their colleagues from Avon. There are two possible reasons for this. First the trial of smart cards in Exmouth in Devon[41] may have raised awareness of potential drug interactions in those GPs in that area. Second, the company Exeter Data Base Systems, who produce *Interlex* (Section 8.1.6.2) is situated in Devon. Again, the local nature of a company gathering drug interaction data and producing systems for GPs may raise the awareness of interactions amongst GPs from Devon. A greater awareness of the existence of potential drug interactions may increase demand for a reference book on the subject.

Little support was shown for the concept of FHSAs maintaining patient records. Fewer than 5% of the respondents stated that FHSAs should keep patient medication records (Table 9.3). A possible reason for GPs not wanting FHSAs to store patient records is a fear of administrative bureaucracies holding confidential information. Four respondents stated explicitly that FHSAs should not hold patient data under any circumstances because of potential problems with a lack of security whereby patient confidentiality could not be guaranteed.

9.4.5 Retention of Records and Recording of Patients' Clinical Details for Selected Medical Conditions

Pharmacists at present can claim payment for maintaining PMRs for the elderly and confused. Table 9.5 shows the level of support amongst GPs for pharmacists maintaining records for these and other patient groups. High levels of support were shown for maintaining records for those patients who have experienced drug allergies and major adverse reactions, as well as for diabetics, asthmatics and epileptics. Lower levels of support were shown for two other important groups of patients: those with cardiac disorders and/or hypertension, or those with a history of peptic ulceration. There are important implications for the safe and appropriate use of non-prescription medicines in each of these conditions. Pharmacy medicines containing sympathomimetic agents such as phenylpropanolamine are significantly cardio-active, and should be used with caution in hypertensive patients. The risks of adverse drug reaction in patients suffering from cardiovascular disorders have been described in Section 7.4.4. Aspirin and ibuprofen, both widely-used analgesics, are contraindicated in patients with active peptic ulcer disease, and must be used with caution in those patients with a history of peptic ulcer.[185]

In the last decade, GPs have become used to working in larger practices with other health professionals who assist in providing patient care, for example specialist diabetes and asthma nurses. GPs will have become used to sharing certain patient information with nursing staff, and so may differentiate between the above patient groups in making a judgement as to for whom pharmacists should keep PMRs.

Two GPs raised the problem of patients' perception of their condition being at variance to their medical records. McElnay and Grainger-Rousseau have shown that total agreement between these two factors as being only 56.1%.[187] However, McElnay and Grainger-Rousseau point out that if a particular condition is omitted from an extended PMR, and a medication contraindicated for that patient is dispensed, then liability for breach of contract could be claimed by the patient. Clearly, this issue, also raised by one respondent during the survey of GPs, requires both legal and ethical debate.

9.4.6 Dispensing Doctors

A number of differences were found between dispensing and non-dispensing doctors. In general, dispensing doctors were less appreciative of the community pharmacists' role than their non-dispensing colleagues. Possible reasons for this are that they see the pharmacist as a perceived pseudo-commercial threat or merely that they have less regular professional contact with pharmacists resulting from pharmacists routinely dispensing prescriptions for their patients and are therefore less well-informed about the pharmacist's scientific and professional knowledge. The majority of non-dispensing doctors were in favour of pharmacists keeping PMRs, compared with a minority of dispensing doctors. Similarly, when presented with the hypothetical situation where primary health care professionals could have selective access to patient records, appropriate to their role, the majority of dispensing doctors were not in favour of community pharmacists having access, in contrast to a minority of non-dispensing

doctors. Curiously, dispensing doctors also were less likely to favour access to patient records by ophthalmic opticians. This is possibly another example of dispensing doctors being concerned about a perceived commercial threat from other professional groups.

Differences were also found between the groups of dispensing and non-dispensing doctors in their opinions towards pharmacists recording details of patients' clinical conditions in PMRs; again the majority of dispensing doctors were not in favour, whereas the majority of non-dispensing doctors were in favour of the recording of clinical conditions.

Given the above lack of support or recognition from dispensing doctors for the community pharmacist, it is not surprising that dispensing doctors were very unlikely to seek the community pharmacist's opinion on potential drug interactions (Table 9.11). However, dispensing doctors were shown to be more likely than non-dispensing doctors to consult the ABPI Data Sheet Compendium[169] and to use District drug information centres for information about potential drug interactions.

9.4.7 The Influence of GP's Year of Registration

GPs who registered before 1962 were less likely than their more-recently registered colleagues to work in a computerised practice. This corresponds with our earlier finding for community pharmacists' use of PMRs, showing lower use among those pharmacists registering before 1961 (Figure 2.2).

Several encouraging trends were detected showing increased support among recently registered doctors for the community pharmacist's extended role in maintaining PMRs (Figure 9.1). Also, although the majority of GPs favoured the concept of selective access by community pharmacists to FHSA-held patient records, significantly fewer

GPs registering in 1962 or earlier supported this concept than their more-recently registered colleagues (Figure 9.2). Support for community pharmacists recording patients' clinical conditions was highest among more-recently qualified GPs (Figure 9.3), who also were more likely to favour pharmacists including the supply of non-prescribed medicines in PMRs. Community pharmacists' use of *PILLS* type patient information leaflets was well supported, especially by those GPs registering since 1983 of whom 93.0% were in favour (Table 9.8).

However in contrast to the above, recently registered GPs were less likely than their more experienced colleagues to "always" welcome information from community pharmacists about potential drug interactions (Figure 9.4). This finding is reinforced by the finding that few recently registered GPs cited the local community pharmacist as a source of information on drug interactions (Table 9.10).

Other observations on the influence of the GP's year of registration on the use of information sources about drug interactions were that more-recently registered GPs tended to show a greater preference for the BNF, and a lesser preference for MIMS[138] and the ABPI Data Sheet Compendium[169]; this would seem to reflect wider use of the new style BNF since its introduction in 1981. Recently-registered GPs will also have become used to the BNF as an important, concise reference during their hospital experience.

9.4.8 Patient Information Leaflets

Almost 80% of all respondents were in favour of pharmacists issuing *PILLS*-type patient information leaflets to patients (Table 9.8), with increased support shown among younger GPs. Respondents were generally positive about the effects of such leaflets on patient compliance. Despite the overall level of approval for patient information leaflets, many GPs expressed adverse opinions towards their use. One felt

that existing leaflets needed to be tailored to an individual patient's needs. Another expressed concern that inadequately educated patients could not cope with such leaflets. The use of "American Data" was disapproved of by one GP.

Three respondents suggested that leaflets should only be given to patients with GPs' approval. One further GP made the suggestion that prescribers could indicate on prescription forms whether leaflets should be issued to patients. Developing this GP's suggestion, FP10 forms could be modified to include an "NL" (no leaflet) box, in the same way that an "NP" (nomen proprium) box already exists. In this way, prescribers could indicate that they did not want patients to be given specific information leaflets with dispensed medicines.

Another GP stated that the best way of providing product information to patients was by means of a leaflet attached to computer-generated FP10 prescription forms. This system would need to overcome the problems associated with the use of hand-written prescriptions. Finally one respondent expressed support for patient regimen charts following the recent publication of Raynor's work in the *BMJ*.[103] Patient regimen charts have also been successfully piloted in Spain by Codina *et al.*[188]

9.4.9 Drug Interaction Reference Sources

Our findings show that the BNF is widely accepted as a reference source on drug interactions, and was regarded as the standard reference source by virtually all respondents. Two respondents commented that the drug interaction information provided in the BNF needed to be more comprehensive. Another respondent expressed the need to have BNF-sourced drug interaction information regularly updated and provided on computer disk. This could then be incorporated into general practice computer systems.

Over 50% of respondents stated that they would use the ABPI Data Sheet Compendium[169] to check a suspected drug interaction. However 15 respondents, albeit a very small percentage, stated that the ABPI Data Sheet Compendium[169] should be regarded as the standard reference source for drug interactions. The ABPI Data Sheet Compendium[169] does not, of course, include generic products as such.

It is interesting that over twice as many GPs in Avon and Devon would consult local hospital pharmacy drug information units in preference to their regional drug information centre in Bristol. This is especially the case for dispensing doctors (Table 9.11). It is possible, of course, that local drug information centres are acting as an intermediary between the GP and the regional drug information centre in Bristol.

9.4.10 General Practitioners' Views on Community Pharmacists' Role Within Primary Health Care

This survey raised the question in GPs' minds of the role of the community pharmacist in primary health care, with particular reference to the clinical role of monitoring the safe and appropriate use of prescribed medication. The issue was well described by one GP who refused to respond to our questionnaire, but for a positive reason. He wrote:

"I did not return the original questionnaire because I believe it addresses the wrong question. Community Pharmacists should be full members of the Primary Health Care team and drawn into Health Centres; firstly to obtain ease of access for patients to pharmaceutical services, secondly to ensure the safety that regular dispensary services from the same site would achieve and thirdly to make the expertise of the pharmacist immediately available to the Primary Health Care team and ensure good communication with the prescribing doctor. Patient medication records cannot achieve the required degree of safety and in my view represent papering over the cracks of

what is fast becoming an inadequate service based on out of date commercial pressures in the pharmaceutical profession."

Other GPs expressed a desire to have community pharmacies within or attached to their premises, providing better access to pharmaceutical services for their patients and the availability of the pharmacist to provide advice.

One general practitioner expressed appreciation over the usefulness of his local community pharmacist's service in monitoring for potential drug interactions, and went on to express some concern that pharmacists were not well funded for this important role. Another respondent expressed concern that pharmacists should receive proper remuneration for maintaining patient records.

Some concerns were expressed about the community pharmacist expanding his clinical role. One GP stated that he realised that his own workload would be increased by the pharmacist having a greater involvement in clinical review, and a further respondent commented that, although appreciative of the good working relationship with local pharmacies, he did not wish to get "bogged down in enquiries about clinical data on patients all the time." The implication of this respondent's comment is that the GP will need to spend time with the community pharmacist in discussing specific patients' problems. Some method of facilitating the means by which community pharmacists and GPs can be freed to have time to discuss patients' medication must surely be found, possibly by means of liaison groups as described by Blenkinsopp *et al.*[184]

Two further comments were less encouraging:

i) "I do not wish the community pharmacist's role to extend into clinical medicine. They should stick strictly to dispensing and not diagnosis, monitoring, counselling as this infringes the GP/patient relationship."

ii) "I would not like to see the pharmacist's role intrude upon treatment and management of patients with hypertension and asthma etc."

These comments express GPs' concerns about the perceived threat of the community pharmacist's role being expanded at the GP's expense, in terms of reducing the importance of the GP/patient relationship.

The commercial nature of the environment in which the community pharmacist practices was of concern to one GP, who stated that both he and his patients were confused by the potential conflict of interest between the sale of non-prescription medicines and the provision of impartial advice as per the BNF.

9.5 Conclusions

1. The results of this survey show that the percentage of GPs using computer systems has continued to rise since 1991. GPs' use of computerised drug interaction monitoring software has increased since 1991, although it still remains low.

2. Despite a majority of GPs being in favour of community pharmacists maintaining PMRs, some GPs remain that unconvinced patients benefiting from pharmacy PMR use. High levels of support were indicated for pharmacists maintaining PMRs for the elderly and confused, and also for those patients experiencing major adverse drug reactions or allergies, diabetics, asthmatics and epileptics.

3. Support by GPs for retention of patients' data by FHSAs was very low.

4. Dispensing doctors were less supportive of the community pharmacist's role in maintaining PMRs than their non-dispensing colleagues.

5. A large majority of GPs expressed positive opinion towards the use of patient information leaflets of the *PILLS*-type by community pharmacists. Most respondents felt that the use of such leaflets had a positive effect on patient compliance.

6. The British National Formulary was GPs' most widely-used reference source on potential drug interactions. An overwhelming majority of GPs felt that the BNF should be accepted as the "standard" reference source on potential drug interactions.

7. GPs hold mixed views on the community pharmacist's clinical role. Further work is required to develop and evaluate systems which facilitate the collaboration of community pharmacists and GPs in monitoring patients' therapy.

10. General Discussion

10.1 The Increasing Use of PMR Systems

In April 1991, 61.5% of our sample of 744 community pharmacies were maintaining PMRs (Table 2.12). This comprised of 55.4% who were using a computer system and 6.1% who were using a manual system. A further 25.1% were either planning to install, or would possibly install a PMR system. One would expect, therefore that the use of PMR systems will have become more widespread in the last two years. Indeed, evidence has been published to support this prediction. In a survey of 293 pharmacies during November 1991, Jepson showed that 77.5% of his sample were maintaining PMRs.[189] Of these, 85% were maintaining computerised PMR systems. Returns from the Royal Pharmaceutical Society's Inspectorate in 1992, showed that 73% of all pharmacies surveyed were using computerised PMR systems.[190]

The results of the study described in Chapter 2 provide data on the use of PMR systems in England and Wales, but not in Scotland or Northern Ireland. However, one would not expect major differences in PMR use between England, Wales, Scotland and Northern Ireland. In a survey commenced during December 1990, Noble and MacDonald found that 57.5% of all pharmacy contractors in the Lothian and the Dumphries and Galloway health board areas were claiming payments for the use of PMR systems.[191] It is, of course, possible that the true number of pharmacies maintaining PMR systems was even higher, since some pharmacies could have been maintaining PMR records without claiming a fee for doing so. In their paper, Noble and MacDonald commented that the number of contractors claiming payment for PMR use was rising steadily as more contractors invested in computerised PMR systems.

From the results of our April 1991 survey (Table 2.12), and from Jepson's November 1991 survey[189], together with the RPSGB Inspectorate's data[190], one can postulate that the percentage of pharmacies in England and Wales using PMRs at the time of

writing (September 1993) will be about 80-85%. While not universal in their use, the maintenance of PMRs can now be considered a normal part of the community pharmacist's professional practice.

10.2 Developments in Pharmacy Computer Use Since April 1991

There have been no radical changes in the availability of PMR systems in the UK over the last two years. During that time, the *Littlefoot* system has been marketed by Surgichem Ltd. for use with their *Nomad* monitored dosage system. The *Littlefoot* system is different from conventional PMR systems in that it maintains patient records on a portable rather than on a desktop computer. The portability of this system means that the pharmacist is able to take the system on domiciliary visits to patients' homes and residential care establishments, though the benefits of this have yet to be established.

The main development in pharmacy computer use over the last two years has been the incorporation of automated prescription endorsement facilities into PMR systems.[192-195] Automated prescription endorsement facilities have been incorporated primarily for commercial, as opposed to professional, reasons although one could argue that community pharmacists are better-placed to provide a professional service if they are able to maximise their remuneration for the service provided.

10.3 "Benchmark" Testing of Pharmacy Computer Systems

The RPSGB recently invited tenders for the evaluation of pharmacy computer systems.[196] It is quite possible that suppliers of pharmacy computer systems will await the outcome of the benchmark testing project before embarking upon the development of new features or improvements to their systems. At the time of writing (September 1993), one can only speculate as to the results of the benchmark testing project. Although, as yet, there is no accepted "minimum" standard or specification

for pharmacy computer systems, it is possible that one will be proposed as a result of the project. If that happens, some existing companies may cease to market PMR computer systems. Should a supplier of pharmacy software cease trading, pharmacies using that supplier's system will have difficulty in maintaining up-to-date drug product and interaction data files. Such a situation could present major difficulties for some pharmacists, given that one cannot easily transfer patient data between systems.

10.4 The Use of Computerised Information in the NHS

Weddell has stated that, for two reasons, "The National Heath Service is renowned for its underuse of computerized data."[197] First, that clinicians and administrators may feel threatened as a result of computerisation, and second, that data held within NHS computers have been considered to be inaccurate. These views are supported by those of Leaning, who noted that information technology in the NHS had been perceived as a management tool of little clinical relevance, and that there had been professional concern that inappropriate computerisation may harm patient care.[198] However in his *BMJ* editorial, Leaning went on to describe a new information management and technology strategy for the NHS in England. The strategy's goal was to promote "better health for the nation" and had five principles: that information should be person based; systems should be integrated; management information should be derived from operational clinical systems; data should be secure and confidential; and data should be shared across the NHS. Similarly, in the USA, arguments are being made for the development of an integrated database, with shared information being available to the various user groups within the health care delivery system.[199]

In November 1991, the Department of Health announced that it was to commission a project to draw up a pharmacy computer standard.[44] Management consultants were asked to draw up guidelines for computer system designers and programmers that would ensure that data could be passed between computers. The implication of this

was that methods of encoding patient data would be developed to facilitate the transfer of patient data between pharmacy and general medical practice computer systems. An advantage of this for both community pharmacists and general practitioners would be that they would not be obliged to use any particular software supplier. Should any particular supplier cease trading, then users of that supplier's system should be able to transfer their patients' data to another system without losing the integrity of the data. Furthermore, if pharmacists and general practitioners were not tied to any particular system, greater competition would ensue between system suppliers, possibly giving an impetus to software development.

The purpose of drawing up a pharmacy computer standard would be to develop and lay down compatible data formats. The basis of such formats are "minimum basic data sets", which are collections of core elements of information, that can be understood by different computers. For example, a Read code could be used to identify a disease state, a PIP code (Pharmaceutical Interface Product code) to identify a particular product, and a personal NHS number to identify an individual patient. It is planned to introduce a new-format all-digit NHS number by 1995.[198] Elsewhere in Europe, the development of a minimum basic data set for use in Spanish general practice has been described by Gervas and Fernandez.[200]

At the time of writing (September 1993), there has been little progress towards achieving minimum basic data sets in pharmacy, although the pharmacy computer benchmark project[196] should lead to some advancement.

Two possible methods of transferring a patient's data between one provider of health care and another are by electronic data exchange or by smart card (Section 1.4). It still is unclear which one of these methods will prove to be the method by which a patient's data will be transferred. The Exmouth smart card trial failed to demonstrate any

conclusive advantages in patient care.[41] Despite this, a further trial of smart cards is taking place in Scotland.[42]

Electronic data exchange between general medical practices and community pharmacies has not yet been piloted in the UK, and so remains to be evaluated. However, a system of electronic data exchange has been piloted in Copenhagen, Denmark.[201] In that project, general practice and pharmacy computers were linked to a network via the public telephone system using standard computer modems. Prescription information was transmitted by the GP to the electronic mailbox of the retrieving pharmacy, whose computer regularly emptied the mailbox and sent a receipt to the GP's mailbox. Such a system could work in the UK, although the Medicines Act 1968 would need to be amended in order for prescription-only medicines to be dispensed without a paper-based prescription form. If electronic data exchange enabled transfer of prescriptions in the UK, community pharmacists would still need to keep their own medication records for previously-dispensed medicines, unless some form of patient medication history could be encoded with the transmitted prescription; however, the latter procedure would seem impractical.

Electronic data exchange in UK primary health care does appear to have a promising future. The Scottish Pharmaceutical General Council has recently announced that the prescription pricing division of the Scottish Common Services Agency has proposed that the current method of sending paper prescriptions to the Prescription Pricing Authority for payment should be replaced by electronic data capture and transmission.[200] The proposed system would become operational in 1995 and fully introduced at the end of 1998.

The leaders of the pharmaceutical profession together with individual pharmacists, both in community and hospital practice, must ensure that they make a full contribution to the development of new health care computer systems. Dasta *et al* have made such

a case in a recent review article: "It is important that pharmacists become active participants in the development of systems that involve drug databases or drug therapy. As such, computers can run in harmony with pharmacists to provide optimal pharmaceutical care."[203]

10.5 The Role of Family Health Service Authorities

FHSAs are gaining in importance in terms of influence over prescribing and the use of medicines in primary health care. Many FHSAs have appointed both medical and pharmaceutical advisers, one of their functions being to bring about more cost-effective prescribing. FHSAs are to be given the role of purchasers of pharmacy services in 1995-96 when local budgets are introduced.[204] It is likely that FHSAs will have an increasing role in monitoring the "extended role" activities of community pharmacists, including the maintenance of PMRs. Hume *et al* have published two papers describing two Scottish health boards' monitoring of patient medication records, and the maintenance of a computerised database for monitoring community pharmacists' extended role contracts.[191,205]

One could envisage a role for FHSAs in the context of storing patients' medical data, which could be accessed by both primary and secondary health care professionals, in a manner appropriate to their roles. Such a system would involve some form of electronic data exchange (Sections 1.4.2, 10.4). However, the survey of GPs, described in Chapter 9, showed very little support among medical practitioners for FHSAs holding patients' medical data (Conclusion 9.5.3).

10.6 Community Pharmacists' Access to Patient Information

The study presented in Chapter 7 has shown the important benefits of community pharmacists monitoring patients' therapy and intervening when appropriate. PMRs have been shown to be of particular benefit when monitoring for potential drug

interactions between previously-dispensed and newly-prescribed medication, and also to prevent medication from being dispensed to patients for whom it is contraindicated. A community pharmacist must have available, at the time of supplying a product, sufficient information as to whether that product is safe for a patient to use. In the author's opinion, "sufficient" information should include a knowledge of the patient's medication history and any clinical condition for which a medicinal product may be contraindicated.

There are three currently-feasible ways in which the community pharmacist can elicit the information described above. First, he can ask the patient; this is far from ideal since the patient may neither give the correct information nor be the person presenting in the pharmacy. The second method is to enquire of the patient's general medical practice staff; this would be impractical for all medication supplies for the reason that it would be too time-consuming. In any case, the general practice surgery would be most unlikely to have details of medication prescribed by dentists, or that obtained without prescription. The third method is by the use of pharmacy-held PMRs, as described in Chapter 2. Pharmacy-held PMRs provide the potential saving of excess patient morbidity as a result of their use (Chapter 7), but they currently are imperfect. There are two primary reasons for this imperfection: many users do not record patients' clinical conditions, and records may be incomplete if patients do not obtain all their medication from the same pharmacy.

The author sees three potential ways to overcome the problem of incomplete information being stored within pharmacy-held PMRs.

First: the universal use of smart cards in the UK would mean that a patient could carry his medical record on a credit-card size smart card. However, the problems of high cost, card-failure and patients not bringing their cards to the surgery and the pharmacy have been described in Section 1.4.1. The author does not consider universal use of

smart cards in primary health care as the solution to the problem of the community pharmacist having comprehensive information about a patient and his medication history.

Registration of patients with a particular pharmacy is the second potential way to overcome the present problem of the pharmacist not having complete information at his disposal. A capitation fee, perhaps for clearly-defined patient groups, should be paid to the community pharmacist for maintaining a patient medication record. Patient registration with a community pharmacy probably would not be difficult to organise and administer, given computerisation and experience of FHSAs in maintaining patient registers; therefore such a system could work. However, the current economic and political climate probably would mitigate against patient registration with a community pharmacy. It could be argued that, in the age of the "free-market" and "consumer-choice", patient-registration may encourage restrictive-practice and discourage competition between pharmacies for a patient's custom. In practice, on grounds of convenience, some patients probably would not want to purchase non-prescription medicines always from the same pharmacy at which they obtain their prescribed medication.

The third, and the author's preferred, method of ensuring that community pharmacists have access to comprehensive patient information would involve electronic data exchange (Sections 1.4.2 & 10.4). Although it would not yet be feasible to have comprehensive electronic data exchange between providers of health care (Figure 1.1), continuing developments in computer technology[206] might permit this method of transmitting a patient's information within the next few years. The problems to be overcome before developing a fully-functional system would include: having sufficiently powerful computers; ensuring adequate data security, and; limiting computer failure with consequent mainframe "down-time." Wherever, and on whatever computer, a patient's medical data would be stored, the community

pharmacist would need access to the patient's medication history and details of relevant clinical conditions. However, the pharmaceutical profession will have to convince the medical profession of the benefit to the patient of the community pharmacist having access to such data. Over 40% of the respondents in the survey of general practitioners (Chapter 9) did not see a role for the community pharmacist in maintaining PMRs (Section 9.4.3). Furthermore, only a very small minority of GPs supported the retention of patients' medical data by FHSAs (Conclusion 9.5.3). This is a major obstacle to be overcome if networking of pharmacies and general practice surgeries is to become commonplace.

10.7 Recording of Patient Conditions

The recording of patient information, particularly clinical conditions, in pharmacy-held PMR systems has been described in Section 2.3.3 and Chapter 4. Details of patients' clinical conditions are required by the community pharmacist for two purposes. The first is to identify needs for service provision and the development of product inventories appropriate to clients' needs (Conclusion 4.5.3). The second is to be in a stronger position to prevent the supply of medication to patients for whom it would be contraindicated. An investigation of the first requirement, although arising from an audit of patients' clinical conditions recorded in a community pharmacy PMR system (Section 4.3), was considered beyond the scope of this thesis. The advantages of a community pharmacist being appraised of a patient's clinical conditions have been demonstrated successfully in the clinical intervention study presented in Chapter 7.

In addition to a pharmacist having access to relevant data (Section 10.6, above), one must consider what makes it important for the pharmacist to know about a particular clinical condition. Table 2.24 shows those clinical conditions that our sample of 744 community pharmacists from the April 1991 survey (Chapter 2) recorded in their PMR systems, ranging from 7.2% of the respondents recording HIV infection, up to 75.9%

of the respondents recording diabetes. In the January 1993 survey of *PILLS*-users (Section 4.2.1), diabetes was the clinical condition most frequently recorded by the respondents. In the audit of clinical conditions recorded in one particular community pharmacy (Section 4.3), where it was the policy to record *all* clinical conditions reported by patients, it was found that the recording of various disease states bore a close relationship to morbidity in the UK population as a whole. The results from the first (April 1991, Chapter 2) and second (January 1993, Section 4.2.1) surveys differed from the third (February 1993, Section 4.3) survey in that the clinical conditions recorded with the greatest frequencies were those in which certain medication may be contraindicated, for example: diabetes mellitus, asthma, epilepsy, hypertension, peptic ulcer. It is the author's opinion that, in the absence of fully comprehensive information about a patient's clinical condition, a community pharmacist should at least record in the PMR those conditions of the patient in which medication may be contraindicated.

10.8 The Use of Pharmacy-held Patient Record Databases

The possibility that auditing their PMRs would provide community pharmacists with a better knowledge of their clientele has been discussed in Section 4.3.4. Comprehensive pharmacy-held PMR databases also could be used as practice research resources. Recently, Beto *et al* used a "pharmacy computer prescription database", ie. a computerised-PMR system, to conduct a quality-of-life study of hypertensive patients in the USA.[207] Beto *et al* sent a questionnaire to a non-random control sample of 635 patients, whose records were maintained on the pharmacy system, and to 100 randomly selected hypertensive patients who were taking one of three specific anti-hypertensive agents. Beto *et al* surveyed attitudes towards their research and found that the participating pharmacists and patients favoured, or did not object to, the research. However, the grant-awarding body expressed some ethical concerns when the sampling techniques were described in the grant proposal, although Beto *et al* stated that the APhA Code of Ethics[208] is used as a basis to provide recommendations

to examine and justify PMR investigative use. Ethical considerations arising from the computerisation of pharmacy, and the retention of patients' records have been discussed by McCarthy and Perrolle.[209] They concluded that areas for discussion as a result of pharmacy computerisation were: the changing relationship between patient and pharmacist; the protection of confidential patient information; and the changing conditions under which patients are monitored and therapy decisions are made.

In the UK, the RPSGB's updated Code of Ethics, published in 1992, states, under the guidance of Obligation 4.2 of Principle Four, that data held in PMR systems may be used where necessary for the purpose of a medical research project which has been approved by a recognised ethical committee.[210] Clearly, community pharmacists are well-placed and able to use their PMR databases as a research resource for such projects. For example, it is well known that the use of NSAIDs may precipitate bronchospasm in susceptible asthmatic patients, yet from the author's experience it is not uncommon in general practice for asthmatics to be prescribed NSAIDs, and subsequently require treatment with bronchodilators and/or increased doses of corticosteroids. A similar situation has been described by Paes in Holland.[128]

10.9 Recommendations

1. When dispensing prescribed medicines or supplying non-prescription medication, community pharmacists should follow a systematic clinical procedure, in addition to adhering to legal and NHS contractual requirements. The following procedure is proposed:

   i) A pharmacist should check that a prescribed or recommended dose is appropriate for the patient.

   ii) The pharmacist should ascertain that the product to be supplied is not contraindicated for that patient.

   iii) The pharmaceutical form of the product to be supplied should be appropriate for the patient. For example, a pharmacist should assess the suitability of solid dose forms for young children.

   iv) The pharmacist should ensure that the product to be supplied does not interact with other prescribed or non-prescription medication currently being, or recently taken by the patient. If the product to be supplied does interact with such medication, the pharmacist must assess critically the relevance and likely severity of the drug interaction for the patient when making a judgement as to whether to supply the product.

2. Community pharmacists should maintain or have access to PMRs for all patients.

3. A pharmacist must have access to sufficient information about a patient to make adequate judgements about whether to permit the supply of prescribed and non-prescription medication.

4. Registration of patients with a particular pharmacy should be considered or otherwise, electronic data exchange systems must be researched and developed to enable the community pharmacist to access details about the supply of medicines from sources other than his own pharmacy. Pharmacists should record in each individual patient record those clinical conditions in which medication may be contraindicated.

5. There are hazards of not being able to detect contraindications or drug interactions due to more than one record being maintained for a given patient in the same pharmacy. There is a requirement for a method to be developed to minimise the risk of record-duplication. The creation of, and access to, a patient's PMR by means of the unique NHS number may be a way of achieving this objective.

6. Community pharmacists are making clinical interventions, using PMRs, to prevent: adverse drug interactions; the supply of contraindicated products; the supply of the wrong product, and ; the supply of medication with an inappropriate dose. The profession must take action to increase awareness of this role among the general public, the medical profession, and Government policy-makers.

7. There are deficiencies in existing drug interaction monitoring software which must be eliminated. Internal audit of pharmacy computer databases by the system supplier, with external audit by appropriate experts would help to eliminate errors and omissions in the databases. The application of expert system programming techniques should be applied to drug interaction monitoring software to develop improved systems which take account of three or more interacting drugs or clinical conditions. The addition of referenced

citations to drug interaction warnings, as is the case with some systems used in the USA, would enhance the quality assurance of computerised-PMR systems.

8. The BNF is widely accepted as a standard reference source on drug interactions. The availability of a frequently-updated on-line version of the BNF would be advantageous.

10.10 Proposals for Future Research

The April 1991 survey of 744 community pharmacies in England and Wales showed that over 61% of the respondents were maintaining PMRs (Conclusion 2.5.1). It is thought that 80-85% of community pharmacies are now maintaining PMRs (Section 10.1). A further survey would be useful not only to confirm this, but also to establish the reasons why the remaining minority of pharmacists who are non-PMR-users have chosen not to establish a PMR system.

The clinical intervention survey described in Chapter 7 showed the potential benefits to patients of community pharmacists maintaining PMRs. Further work is required to establish cost-benefits which accrue as a result of clinical interventions made by community pharmacists using PMRs. Such work would involve an expert panel establishing the probability of adverse reactions arising had the community pharmacist not intervened. This would then require an evaluation of the costs of medical and paramedical involvement, hospitalisation, corrective drug therapy, and absence from employment resulting from morbidity associated with adverse reactions.

PMR databases held in community pharmacies could have a use in adverse drug reaction monitoring. Beta-adrenoreceptor antagonists and NSAIDs may produce bronchospasm in susceptible patients, particularly those with a history of obstructive airways disease. In spite of this, the author's community practice experience shows that these drugs are still prescribed for such patients when they are contraindicated. PMR systems could be improved, by researching and developing better methods of interrogating the databases, in order to determine the extent of this problem, and, furthermore, warn the pharmacist of those patients most at-risk. The pharmacist would then be able to use this information to advise patients' GPs to monitor them closely.

The deficiencies of software used to monitor for potential drug interactions has been discussed in Chapter 8. The concept of "ternary systems" for evaluating potential drug interactions has been discussed in Section 8.4.8. Research is required to establish the exact need for such systems, that is, the number and importance of complex drug interactions involving three or more products must be determined. Furthermore, the number of specific clinical conditions in which a particular drug interaction may be of clinical significance must be determined. On the basis of such preliminary studies, suitable algorithms would be produced to develop the software, possibly involving expert system techniques.

The study of clinical intervention events produced evidence that GPs hold mixed views on the community pharmacist's clinical role. Research is required to develop and evaluate the collaboration of community pharmacists and GPs in monitoring patients' therapy.

Bibliography

1. Nuffield Foundation Committee of Inquiry. *Pharmacy: the report of a committe of inquiry appointed by the Nuffield Foundation.* London: Nuffield Foundation, 1986.

2. Dalglish D. Keeping script records. *Chemist and Druggist* 1972; **197**: 848.

3. Balmford JE. A "mark 2" patient medication record system. *Chemist and Druggist* 1976; **206**: 54-55.

4. O'Hara GL. Patient medication profile monitoring. *JAMA* 1976; **16(5)**: 248-70.

5. Finlayson FG, Booth TG, Jones IF. Economic forecast of providing a patient record system in general practice pharmacy. *Pharm J* 1977; **219**: 234.

6. Shulman JI, Shulman S. Two card system for monitoring patient medication in general practice pharmacy. *Pharm J* 1978; **221**: 331-332.

7. Shulman JI, Shulman S. Operating a two card medication record system - a role for pharmacists in the 1980's? *Pharm J* 1979; **222**: 554-556.

8. Karig AW, James JD, Braunstein ML, Henderson WM. The family pharmacist and computerized patient records: A training program and practice model. *Am J Pharm Educ* 1974; **38**: 161-8.

9. Unichem launches Prosper stock control scheme. *Pharm J* 1978; **221**: 63.

10. Computer technology in pharmacy practice. *Pharm J* 1979; **223**: 226-227.

11. Winters J. Computers within pharmacy practice. *Pharm J* 1980; **225**: 384-6.

12. Morris G. Patient medication records: A personal view. *Pharm J* 1989; **242**: 351-2.

13. Stevens R. The evolution of patient medication records in British community pharmacy. *Int J Pharm Pract* 1991; **1**: 64-72.

14. Teeling-Smith G. The next 30 years: a golden age for pharmacy. *Pharm J* 1982; **226**: 149-150.

15. Communication in the community. *Pharm J* 1984; **233**: 572-3.

16. Lutz L. Computers and health care. *Am Pharm* 1984; **NS24 10**: 54-61.

17. McKay AB. Computers in home health care: Present and future impact. *Am Pharm* 1985; **25(9)**: 48-51.

18. Moss RL, Pounders JN. Impact of computerization on dispensing time in an ambulatory-care pharmacy. *Am J Hosp Pharm* 1985; **42**: 309-311.

19. Berger B. Pharmacy computers - Are we ready for them? *Am Pharm* 1985; **25 (11)**: 56-59.

20. Stevens RG, Crabbe AM. Computers in community pharmacy. *Pharm J* 1987; **236**: 267-8.

21. Patient medication records: which system? *Pharm J* 1989; **242**: 345-348.

22. Wood NL. Patient records: Where next? *Pharm J* 1988; **240**, 222-3.

23. Promoting better health. The Government's programme for improving primary health care. Department of Health and Social Security. London: HM Stationery Office, 1987.

24. Pharmaceutical care: The future for community pharmacy. London. RPSGB, 1992.

25. Drug interaction alert. Boehringer Ingelheim. Bracknell, annual.

26. Boakes RM, Strickland-Hodge B, Jepson MH, Kendall HE. Computers in community pharmacy: a national survey of current uses and future developments. *Pharm J* 1990; **244:** 620-623.

27. Strickland-Hodge B. Drug interaction software. *Chemist & Pharmacy Update* 1989; Oct 30-2.

28. Stevens RG, Crabbe AM. Patient medication records - evaluation of a drug interaction routine and potential for time saving. *Int J Pharm Pract* 1991; **1**: 41-44.

29. Strickland-Hodge B. Just for the record. *Chemist & Pharmacy Update*1989; Nov/Dec 24-5.

30. Preece J. The use of computers in general practice. 2nd edn. London: Churchill Livingstone, 1988.

31. Hadley MP. Patient leaflets. *Pharm J* 1989; **243**, 155.

32. Ley P. Communicating with patients. 1988. London: Croom Helm.

33. Davies PS, Rubinstein MH. Patient medication records - An investigation into the patient-pharmacist relationship. *Pharm J* 1989; **243**: R27.

34. Britten N, Gallagher K, Gallagher H. Patients' views of computerised pharmacy records. *Int J Pharm Pract* 1992; **1**: 206-9.

35. Di Ponio S, Boakes RM, Strickland-Hodge B. Letters- patient medication records. *Pharm J* 1989; **243**: 127.

36. Walsworth-Bell JP. The use of smart cards in the NHS. *Health Trends* 1988; **20**: 86-89.

37. Stevens, R.G. Smart moves. *British Jouranl of Healthcare Computing* 1988; **5**: 28-31.

38. Stevens RG, Crabbe AM. Credit card medication records.*Pharm J* 1987; **239**: 724-9.

39. Stevens RG, Crabbe AM. The Rhydyfelin computer card medication record trial-impressions after three years. *Pharm J* 1991; **246**: 27-30.

40. Stevens RG. Pharmacy aspects of the Exmouth Care Card Trial. *Pharm J* 1991; **246**: 359-61.

41. NHS Management Executive. The care card. Evaluation of the Exmouth project. HMSO. London, 1990

42. Computer health data card project to start in Scotland. *Pharm J* 1993;. **250**: 77.

43. Ornstein SM, Oates RB, Fox GN. The computer-based medical record: Current status. *Journal of Family Practice* 1992; **35(5)**: 556-65.

44. NHS pharmacy computer standard to be drawn up. *Pharm J* 1991; **247**: 621.

45. Masys DR. Of codes and keywords: Standards for biomedical nomenclature. *Academic medicine* 1990; **65**: 627-9.

46. Lambert H, Wood M, editors. International Classification of Primary Care. Oxford. Oxford Medical Publications, 1987.

47. Chisholm J. The Read clinical classification. *BMJ* 1990; **300**: 1092.

48. Read J, Benson T. Comprehensive coding. *British Journal of Healthcare Computing* 1986; **3**: 22-5.

49. Pringle M. The new agenda for general practice computing. *BMJ* 1990; **301**: 827-8.

50. Bryman A, Cramer D. Quantitative analysis for social scientists. London: Routledge, 1990.

51. Leedy P. Practical research. Planning and design (4th edn). New York: Macmillan, 1989.

52. Sudman S, Bradburn NM. Asking questions. A practical guide to questionnaire design. London: Jossey-Bass, 1982.

53. Norussis M. SPSS/PC+ Base manual. Chicago. SPSS Inc., 1990.

54. Reid I. Social class differences in Britain (3rd edition). Glasgow: Fontana 1989.

55. Monk D. Social grading on the national readership survey. London: Joint industry committee for national readership surveys, 1985.

56. Laurence DR, Bennett PB. Clinical pharmacology. (6th edition). Edinburgh. Churchill Livingstone, 1987.

57. Rowland M. Variability and the individual. *Pharm J* 1993; **251**: 408-410.

58. Dale JR, Appelbe GE. Pharmacy law and ethics. (4th edition). London. Pharmaceutical press, 1989.

59. Stockley I. Drug interactions (2nd edition). Blackwell. Oxford, 1991.

60. Drug Tariff June 1991. Department of Health. Welsh office.

61. Manchester school of pharmacy wins £35 000 grant for evaluation of patient medication records. *Pharm J* 1990; **245**: 716.

62. Freude N. A guide to SPSS/PC+. London. MacMillan, 1987.

63. Siegel S, Castellan NJ. Nonparametric statistics for the behavioural sciences. 2nd edn. New York. McGraw Hill, 1988.

64. Norussis M. SPSS/PC+ Statistics 4.0. Chicago. SPSS Inc., 1990.

65. Rogers PJ, Fletcher G, Rees JE. Patient medication records in community pharmacy. *Pharm J* 1992; **248:** 193-6.

66. Rogers PJ, Fletcher G, Rees JE. The labelling of prescriptions presented with incomplete dosage directions. *Pharm J* 1992; **249:** R38.

67. Rogers PJ, Fletcher G, Rees JE. Recording of clinical conditions by community pharmacists in patient medication records. *Pharm J* 1992; **249:** 723-7.

68. Richards ID, Baker MR. The epidemiology and prevention of important diseases. Edinburgh: Churchill Livingstone, 1988.

69. Abuzeineh N. Freeing pharmacy from "computerphobia" (letter). *Am Pharm* 1982; **22 (4)**, 3.

70. Analysis of students at schools of pharmacy. *Pharm J* 1962; **189**: 595-6.

71. Feely J. The pollen count is high. *Over the counter.* June/July 1992: 20.

72. Rogers L. Sneezing our way to fever pitch. *Sunday Times*, 30 May 1993.

73. Medication records of immense benefit. *Chemist & Druggist* 22 September 1990: 518.

74. Marriott JF. Patient medication records (letter). *Pharm J* 1992; **249**: 139.

75. Likert RA technique for the measurement of attitudes. *Psychology* 1932; **140**: 5-55.

76. Elworthy PH. The work pattern of women pharmacists, 1966-83. *Pharm J* 1986; **237**: 218-24.

77. Council statement: printed labels. *Pharm J* 1983; **231**: 749.

78. Diamond G. The next step in pharmacy computer technology. *Pharm J* 1992; **248,** 683.

79. Rogers PJ, Fletcher G, Rees JE. Reasons for community pharmacists establishing patient medication records. *Int J Pharm Pract* 1993; **2**: 44-8.

80. Morbidity statistics from general practice: Third national study. London. HMSO, 1986

81. British National Formulary Number 21 London. British Medical Association / Royal Pharmaceutical Society of Great Britain, 1991.

82. Ley P, Bradshaw PW, Eaves D, Walker CM. A method for increasing patients' recall of information presented by doctors. *Psychol Med* 1973; **3**: 217-20.

83. Davis TC, Crouch MA, Wills G, Miller S, Abdehou DM. The gap between patient reading comprehension and the readability of patient education materials. *J Fam Pract* 1990; **31**: 533-8.

84. Sutton A, Smart JD, Herring CN. Patient information leaflets - The patient's perspective. *Pharm J* 1989; **243**: R43.

85. Miselli M. What information for the patient? Large scale pilot study on experimental package inserts giving information on prescribed and over the counter drugs. *BMJ* 1990; **301**: 1261-5.

86. Gibbs S, Waters WE, George CF. The benefits of prescription information leaflets (1). *B J Clin Pharmac* 1989; **27**: 723-39.

87. Gibbs S, Waters WE, George CF. The benefits of prescription information leaflets (2) . *B J Clin Pharmac* 1989; **28**: 345-51.

88. Gibbs S, Waters WE, George CF. Communicating to patients about medicine: Prescription information leaflets: a national survey. *J Royal Soc Med* 1990; **83**: 292-7.

89. Gibbs S. Prescription information leaflets for patients. *Eur Resp J* 1992; **5(1)**: 140-3.

90. George CF. Package inserts. *Br J Hosp Med* 1992; **47 (4)**: 286-8.

91. Parker MH. Patient leaflets (letter). *Pharm J* 1989; **243**: 63.

92. Dodds LJ. Effects of information leaflets on compliance with antibiotic therapy. *Pharm J* 1986; **236**: 48-51.

93. Kitching JB. Patient information leaflets- the state of the art. *J Royal Soc Med* 1989; **83**: 298-300.

94. The Medicines (Leaflets) Amendment Regulations 1992, SI 1992 No 3274. London HM Stationery Office.

95. Association of the British Pharmaceutical Industry. Information to Patients on Medicines. 1987. London.

96. Griffin JP. Original manufacturers' packs and patient information leaflets- a patient's protection and right to know. *J R Coll Physicians* 1991; **25 (3)**: 223-4.

97. Raynor DK. Patient information leaflets. *Pharm J* 1987; **239**: 282.

98. Leaflets-friend or foe? Chemist & Druggist 2 February 1991: 172-3.

99. Peura S, Klaukka T, Hannula AM, Eerikäinen S. Electronically produced information leaflets increase patients' understanding of antibiotics. *Int J Pharm Pract* 1993; **2**: 22-5.

100. Baker G. Writing easily read patient information handouts: a computerized approach. *Seminars in dermatology* 1991; **10(2)**: 102-6.

101. Flesch R. A new readability yardstick. *J App Psychol* 1948; **32**: 221-33.

102. Dodds L. Industry-produced patient information leaflets: Are hospital pharmacies making use of them? *Pharm J* 1993; **250**: 311-4.

103. Raynor DK, Booth TG, Blenkinsopp A. Effects of computer generated reminder charts on patients' compliance with drug regimens. *BMJ* 1993; **306**: 1158-61.

104. Lockwood WA. Take a close look. *Computertalk* 1992; **12 (2)**: 6-53.

105. Daniels A, Coulter A. How to choose a general practice computing system: comparison of commercial packages. *BMJ* 1988; **297**: 838-40.

106. Tatro A (ed.). Facts and comparisons. Wolters-Kluwel, St Louis, 1992.

107. Hansten PD, Horn JR. Drug interactions, 6th ed. Lea and Febiger: Philadelphia, 1990.

108. USP DI. United States Pharmacopoeia Convevtion, Inc. Rockville. Annual.

109. Zucchero F, Hogan M. (eds.) Evaluations of drug interactions. Professional Drug Systems, Inc. St Louis.

110. Evans N. The emergency supply of prescription only medicines. *Pharmacy Update* 1988; **4(10)**: 376-8.

111. Strand LM, Cipolle RJ, Morley PC. Documenting the clinical pharmacist's activities: back to basics. *DICP* 1989; **22**; 63-6.

112. Huntress JD, Possidente CJ, Harry DJ. Documenting pharmacists' interventions on a hospital's mainframe computer system. *Am J Hosp Pharm* 1990; **47**: 2711-5.

113. Catania HF, Yee WP, Catania PN. Four years' experience with a clinical intervention program: Cost avoidance and impact of a clinical coordinator. *Am J Hosp Pharm* 1990: **47**: 2701-5.

114. Brown G. Assessing the clinical impact of pharmacists' interventions. *Am J Hosp Pharm* 1991; **48**: 2644-7.

115. Donelly R *et al.* Recording clinical pharmacist interventions: Is there a better way? *Aust J Hosp Pharm* 1991. **21(3),** 158-62.

116. Schumock GT, Hutchinson RA, Bilek BA. Comparison of two systems for documenting pharmacist interventions in patient care. *Am J Hosp Pharm* 1992; **49**: 2211-7.

117. Kwan TC, Wahba WW, Wildeman RA. Drug interactions: A retrospective study of its epidemiology, clinical significance and influence upon hospitalization. *Can J Hosp Pharm* 1979; **28(1)**: 12-16.

118. Rupp MT, Schondelmeyer SW, Wilson GT, Krause JE. Documenting prescribing errors and pharmacist interventions in community pharmacy practice. *Am Pharm* 1988; **NS28 (9)**. 30-37.

119. Rupp MT. Evaluation of prescribing errors and pharmacist interventions in community practice: an estimate of "value added". *Am Pharm* 1988; **NS28 (12)**: 22-26.

120. Rupp MT, DeYoung M. Reactive pharmacist interventions: Results from a spontaneous reporting program. *J.Pharmacoepidemiology* 1991; **2(1)**: 35-49.

121. Rupp M.T., DeYoung M, Schondelmeyer SW. Prescribing problems and pharmacist interventions in community practice. *Medical Care* 1992; **30 (10)**: 926-40.

122. Rupp MT. Value of community pharmacists' interventions to correct prescribing errors. *Ann Pharmacother* 1992; **26**: 1580-4.

123. Maguire TA, Lowry J. A prescription audit: Some implications for community pharmacy. *Pharm J* 1990; **245**: R8.

124. Neville RG, Robertson F, Livingstone S, Crombie IK. A classification of prescription errors. *J Rl Coll Gen Pract* 1989; **39**: 110-112.

125. Vitillo JA, Lesar TS. Preventing medication prescribing errors. *DICP, The Annals of Pharmacotherapy* 1991; **25**: 1388-94.

126. Payne M, Thomas J, Allwood MC. A study of the use of patient medication records in a community pharmacy. *Pharm J* 1992; **249** R39.

127. Rogers PJ, Baxter K, Fletcher G. Computer generated prescriptions - An improvement on hand writing? *Pharm J* 1991; **247**: R29.

128. Paes AHP. Drug monitoring in community pharmacy. *J. Social and Administrative Pharmacy* 1992; **9 (1)**: 29-34.

129. Ventricular arrhythmias due to terfenadine and astemizole. Current problems No.35. November 1992. Committee on Safety of Medicines; 1-2.

130. Lawrie WK. Co with everything. *Pharm J* 1985; **234**: 491.

131. Goves JR, Davies T, Reilly T. Computerisation of primary care in Wales. *BMJ* 1991; **303**: 93-4.

132. Rogers PJ, Fletcher G. Computerisation of primary care in Wales. (letter) *BMJ* 1991; **303**: 367.

133. Reynolds JF. (ed.). Martindale. The Extra Pharmacopoeia 29th edn. London: Pharmaceutical Press, 1989.

134. Council of the Royal Pharmaceutical Society of Great Britain. Guidelines on pharmacy computer systems.*Pharm J* 1989; **242**, 348-50.

135. Maurer PM, Bartowski RR. Drug interactions of clinical significance with opiod analgesics. *Drug Safety* 1993; **8** (1): 30-48.

136. McInnes GT, Brodie MJ. Drug interactions that matter - a critical appraisal. *Drugs* 1988; **36**: 83-110.

137. Pohjola-Sintonen S, Vitasalo M, Neuvonen P. Torsades de pointes after terfenadine-itraconazole interaction. *BMJ* 1993; **306**: 186.

138. Monthly index of medical specialities. London: Haymarket Medical Ltd. Monthly.

139. Johnson AG, Seideman P, Day RO. Adverse drugs interactions with nonsteroidal anti-inflammatory drugs (NSAIDs): Recognition, management and avoidance. *Drug Safety* 1993: **8** (2): 99-127.

140. Dunn F, Lip G. Potential drug interactions in heart disease. *Practitioner* 1992; **236**: 737-9.

141. Jankel CA, Speedie SM. Detecting drug interactions: a review of the literature. *DICP, The Annals of Pharmacotherapy* 1990; **24**: 982-9.

142. Gibaldi M. Drug interactions: Part I. *DICP, The Annals of Pharmacotherapy* 1992; **26**: 709-13.

143. Gibaldi M. Drug interactions: Part II. *DICP, The Annals of Pharmacotherapy* 1992; **26**: 829-34.

144. Martindale On-Line Launch. *Pharm J* 1984; **232**: 734.

145. Lowenthal W. Therapeutic incompatibilities: storage and retreival by computer. *DICP* 1970; **4**: 240-2.

146. Edmond ED, Al-Hamouz A, Tallis RC, Vellodi C. Determining drug-drug interactions and related effects on microcomputers. *Computers and Biomedical Research* 1987; **20**: 85-98.

147. Shinn AF. Clinical relevance of cimetidine drug interactions. *Drug Safety* 1992; **7(4)**: 245-267.

148. Hansten PD. Drug interactions with antisecretory agents. *Alimentary Pharmacology and Therapeutics* 1991; **5 (S1)**: 121-128.

149. Pinciroli F, Pozzi G. A drug-to-drug interaction package. *Computer Methods and Programs in Biomedicine* 1989; **28**: 183-9.

150. Gardner D, Rizack M. A Prolog knowledge base for drug interactions. *Computers and Biomedical Research* 1990; **23**: 139-152.

151. Dolin RH. Interfacing a commercial drug-interaction program with an automated medical record. M.D. *Computing* 1992; **9(2)**: 115-8.

152. Fox GN. Drug interactions software programs. *J Fam Pract* 1991; **33(3)**: 273-80.

153. Haumschild MJ, Ward ES, Bishop M, Haumschild MS. Pharmacy-based computer system for monitoring and reporting drug interactions. *Am J Hosp Pharm* 1987; **44**: 345-8.

154. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: Part 1-Hansten drug interaction knowledge base. *Hospital Pharmacy* 1988; **23**;1062-79.

155. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: Part 2-Drug Interactions Advisor. *Hospital Pharmacy* 1989; **24**; 125-56.

156. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: Drug Master 89. *Hospital Pharmacy* 1989; **24**; 522-6.

157. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: Drug Interactions III. *Hospital Pharmacy* 1989; **24**; 936-40.

158. Poirier TI, Giudici R. (1990). Drug interaction microcomputer software evaluation: RxTriage. *Hospital Pharmacy* 1990; **25**; 136-40.

159. Poirier TI, Giudici R. Drug interaction microcomputer software evaluation: The Medical Letter Drug Interactions Program. *Hospital Pharmacy* 1990; **25**; 458-61.

160. Poirier TI, Giudici R. (1990). Drug interaction microcomputer software evaluation : Drug Therapy Screening System (DTSS). *Hospital Pharmacy* 1990; **25**; 738-42.

161. Poirier TI, Giudici R. Drug interaction microcomputer software evaluation: Dambro's Drug Interactions. *Hospital Pharmacy* 1990; **25**; 30-72.

162. Poirier TI, Giudici R. Drug interaction microcomputer software evaluation: PDR's Drug Interactions and Side Effects Diskettes. *Hospital Pharmacy* 1990; **25**; 839-51.

163. Poirier TI, Giudici R. Drug interaction microcomputer software evaluation: S.O.A.P. *Hospital Pharmacy* 1990; **26**; 342-7.

164. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: Medicom Micro Plus. *Hospital Pharmacy* 1990; **26**; 342-7.

165. Poirier TI, Giudici R. Evaluation of drug interaction microcomputer software: comparitive study. *Hospital Pharmacy* 1991; **26**; 30-5.

166. Jankel CA, Martin BC. Evaluation of six computerized drug interaction screening programs. *Am J Hosp Pharm* 1992; **49:** 1430-4.

167. Poirier TI, Giudici R. Evaluation of drug-food/nutrients interaction microcomputer software programs. *Hospital Pharmacy* 1991; **26**; 533-40.

168. Drug information available on JRC pharmacy systems. *Pharm J* 1992; **249**: 679.

169. ABPI Data Sheet Compendium 1993-4. Datapharm Publications, London.

170. Pennell DJ *et al.* Fatal Stevens-Johnson syndrome in a patient on captopril and allopurinol. *Lancet* 1984 i; 463.

171. Samanta A, Burden AC. Fever, myalgia and arthralgia in a patient on captopril and allopurinol. *Lancet* 1984 i; 679.

172. Rogers PJ, Carroll J, Rees JE. Problems associated with drug interaction monitoring software. *Pharm J* 1993: **251**: R23.

173. Mannio S, GarciaRodriguez LA, Jick SS. NSAIDs, quinolones and convulsions: An epidemiological approach. *Post Marketing Surveillance* 1992; **6(2)**: 119-128.

174. Stork MW, Greene RJ. Expert systems in pharmacy practice. *Int J Pharm Pract* 1993; **2**: 53-7.

175. Wyatt J. Computer-based knowledge systems. *Lancet* 1991; **338**: 1431-6.

176. Wyatt J. Evaluating medical expert systems: what to test and how. *Med Inform* 1990; **15(3)**: 205-17.

177. Kay S. Towards relevant medical information systems. *Medical Informatics* 1990; **15**: 327-31.

178. General Practice Computing. Evaluation of the 'Micros for GPs' Scheme: Final Report 1985. London, HMSO.

179. Kalra D. Medical records. *The Practitioner* 1992; **236**: 533-5.

180. Working for patients. Department of Health. London: HM Stationery Office, 1989.

181. Roberts D. Dispensing by the community pharmacist: an unstoppable decline? *J R Coll Gen Pract* 1988; **38**: 563-4.

182. Spencer JA, Edwards C. Pharmacy beyond the dispensary: general practitioners' views. *BMJ* 1992; **304**: 1670-2.

183. Ellis BC Dovey SM Collins DM Clark DWJ. General practititioners' views on the role of the community pharmacist. *NZ Med J* 1992; **105**: 403-5.

184. Blenkinsopp A *et al.* Community pharmacist and general practitioner liaison groups: (1) The Airedale/Bradford experience. *Pharm J* 1993; **250**: 430-1.

185. Knodel LC. NSAID effects & interactions: Who is at risk? *Am Pharm* 1992; **NS32(3)**: 39-47.

186. Beeley L. Safer prescribing: a guide to some problems in the use of drugs. Oxford: Blackwell Scientific, 1987.

187. McElnay JC, Grainger-Rousseau TJ. Assessment of chronic disease status in the community pharmacy. *Int J Pharm Pract* 1992; **1**: 233-7.

188. Codina CJ, Sarda PU, Salvador EL, Monterde JJ, Ribas JS. Database program for creating individualized patient drug information and medication schedules. *Am J Hosp Pharm* 1992; **49 (1)**: 131-2.

189. Jepson MH. Influences on general practitioner prescribing with particular reference to community pharmacy. PhD Thesis, Aston University 1992.

190. Pharmacy Survey 1992 - Confidential Survey by the Council of the Royal Pharmaceutical Society of Great Britain, 1992.

191. Noble SC, MacDonald A. Monitoring of patient medication records in two Scottish health board areas. *Pharm J* 1992; **249**: 406-8.

192. Automated script endorsement introduced by Medicopharma. *Pharm J* 1991; **247**: 367.

193. Second computerised prescription endorsement system reaches market. *Pharm J* 1992; **249**: 173.

194. AAH launches computerised prescription endorsement system. *Pharm J* 1992: **249**: 361.

195. JRC introduces prescription endorsement computer program. *Pharm J* 1992; **249**: 598.

196. Evaluation of community pharmacy computer systems. *Pharm J* 1993; **250**: 16 January 1993, A7.

197. Weddell J. Computerized health service information: is it used? *Br J Hosp Med* 1991; **45,** 216-9.

198. Leaning MS. The new information management and technology strategy of the NHS. *BMJ* 1993; **307**:217.

199. Stead WW. Systems for the year 2000: The case for an integrated database. *MD Computing* 1991; **8(2)**: 103-110.

200. Gervas J, Fernandez MP. (1992). Minimum basic data set in general practice: Definitions and coding. *Family Practice*; **9(3)**: 349-52.

201. Computers in community pharmacy. *Pharm J* 1991;**247**: 406.

202. Computer links for Scottish script pricing. *Pharm J* 1993; **251**: 339.

203. Dasta JF, Greer MJ, Speedie SM. Computers in healthcare: overview and bibliography. *Ann Pharmacother* 1992; **26**: 109-17.

204. Hidden agenda. *Pharm J* 1993; **251**: 301.

205. Hume A, MacDonald A, Noble SC. A computerised database for monitoring extended role contracts. *Pharm J* 1992; **249**: 93-6.

206. Frankenfield FM. Trends in computer hardware and software. *Am J Hosp Pharm* 1993; **50**: 707-11.

207. Beto JA, Geraci MC, Marshall PA, Bansal VK. Pharmacy computer prescription databases: Methodologic issues of access and confidentiality. *Ann Pharmacother* 1992; **26**: 686-91.

208. Code of ethics. American Pharmaceutical Association. Washington DC., 1981.

209. McCarthy RL, Perrolle JA. Ethics and the computerization of pharmacy: *Am J Pharm Educ* 1991; **55**: 218-225.

210. Code of ethics. Council of the Royal Pharmaceutical Society. London, 1992.

Appendix 1: Statistical Methods

Levels of Measurement

Statistical tests were chosen depending on the scale of measurement of the variables being measured. Measurements may either be on the nominal, ordinal or interval/ratio scale of measurement. Nominal measurement is categorical, based on variable names, and is used for frequency data, and is the weakest level of measurement. The chi-square test is the statistical test used in inferential statistics when measuring data at the nominal level.

Ordinal measurement is based on order or rank, where one variable is ranked higher or lower than another variable. However differences between ranks are not quantifiable. Non-parametric tests are used in inferential statistics when measuring data at the ordinal level.

Interval/ratio measurements are based upon distances between numbers which are quantifiable. Parametric tests are used in inferential statistics when measuring data at the interval/ratio level, and assume the data to come from a normally distributed population. Parametric tests provide the strongest level of measurement.

Statistical tests are devised and used such that an initial hypothesis (H_0) is stated, where there are said to be no differences between measured variables. A test statistic is calculated. If the value of the test statistic is greater than a given critical value, H_0 may be rejected. Critical values vary with the significance level of a test. Generally, a significance level of $p<0.05$ is applied. That is, there is a less than 1 in 20 chance that the result of the statistical test could have occured by chance.

Chi-Square Test For Independent Samples

When the data consist of frequencies in discrete categories, the chi-square test may be used to determine the significance of difference between two or more independent groups. The data are arranged into a frequency table in which the columns represent groups and each row represents a category of the measured variable.

For k independent samples, the null hypothesis (H_0) states that the groups are from the same population. The test statistic is given by

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{k}\left\{\frac{(n_{ij}-E_{ij})^2}{E_{ij}}\right\}$$

where n_{ij} = observed number of cases categorized in the *i*th row of the *j*th column

E_{ij} = number of cases expected in the *i*th row and *j*th column when H_0 is true.

H_0 may be rejected if χ^2 exceeds a *critical value* , at a given probability, for the number of *degrees of freedom* in the frequency table. The number of degrees of freedom (*df*) is given by

df = (number of rows - 1) x (number of columns - 1).

Kruskal-Wallis One-way Analysis of Variance

The Kruskal-Wallis one-way analysis of variance by ranks is a non-parametric test used to decide whether *k* independent samples are from different populations. The Kruskal-Wallis technique tests the null hypothesis that *k* independent samples come from the same or identical populations with the same median. The data are cast into a two-way table with each column representing each successive sample or group. Each of the *N* observations are replaced by ranks, where all of the scores from the *k* samples are combined and ranked in a single series. The smallest score is replaced by rank 1, the next smallest by rank 2 and so on. The test statistic, *H*, is given by

$$H = \left\{ \frac{12}{N(N+1)} \sum_{j=1}^{k} n_j \bar{R}^2_j \right\} - 3(N+1)$$

where k = number of samples or groups

nj = number of cases in the jth sample or group

N = number of cases in the combined sample (the sum of the nj's)

R_j = sum of ranks in the jth sample or group

$\bar{R}_j$ = average of the ranks in the jth sample or group

$\bar{R} = (N+1)/2$ = the average of the ranks in the combined sample.

Ties between two or more scores may arise. The variance of the sampling distribution is influenced (Siegel, 1988) by ties, and this can be corrected for in the calculation for *H*, where the *H* statistic is given by:

$$H = \frac{\left\{ \frac{12}{N(N+1)} \sum_{j=1}^{k} n_j \bar{R}^2_j \right\} - 3(N+1)}{1 - \left\{ \sum_{i=1}^{g} \left(t_i^3 - t_i \right) \right\} \Big/ \left(N^3 - \mathrm{n} \right)}$$

where g= number of groupings of tied ranks

t_i = number of tied ranks in the ith grouping

The effect of correcting for ties is to increase the value of H and thus to make the result more significant than it would have been if no correction had been made. H_0 may be rejected if H exceeds the critical value.

Appendix 2. Survey Questionnaires and Documentation.

April 1991 Questionnaire and Covering Letter Sent to Pharmacies in National Survey and 124 PILLS System Users

Dear Fellow Pharmacist

Patient Medication Records in Community Pharmacy

The Pharmacy Practice Research Unit at the School of Pharmacy and Pharmacology, University of Bath is conducting a research project on the developing use of patient medication records (PMRs) in community pharmacy.

We are examining how PMRs are currently being used in a variety of locations and how their use may further develop. With this objective, we are asking a number of pharmacists, selected at random from the Royal Pharmaceutical Society of Great Britain's Register of Premises, to complete a questionnaire about their attitudes to, and use of, PMR systems.

We would be very grateful if you could find a few minutes in which to complete the enclosed questionnaire and return it in the enclosed freepost envelope.

All responses will be dealt with in the strictest confidence and will not be disclosed to a third party under any circumstances. Results will be processed and stored in a coded format which can only be read by ourselves. The name and address of the relevant pharmacy will not be identifiable from the data, which will only be used for the purposes of this study and not made available for other purposes.

Your response is most important as it will enable us to determine the current use of PMRs, and to project potential uses. If you have any questions about our research we would be pleased to hear from you.

Thank you for your assistance.

Yours sincerely

Philip J Rogers
Teacher Practitioner

John E Rees
Professor of Pharmaceutics

George Fletcher
Lecturer in Pharmacy Practice and Pharmaceutics

PHARMACY PRACTICE RESEARCH UNIT
SCHOOL OF PHARMACY AND PHARMACOLOGY
UNIVERSITY OF BATH
CLAVERTON DOWN
BATH BA2 7AY

PATIENT MEDICATION RECORDS IN COMMUNITY PHARMACY

This questionnaire should be completed by the pharmacist normally in charge of the pharmacy.

All answers will be treated in the strictest confidence and will not be disclosed to any third party under any circumstances.

For office use only

Please tick <u>one box</u> for each question unless otherwise specified.

ID ____ 1-4
Reg __ 5-6

SECTION A: THE PHARMACY

1. Is your pharmacy? *Own _ 7*

independent []

small multiple (group of ten or less pharmacies) []

large multiple (group of eleven or more pharmacies) []

2. How would you describe the location of your pharmacy *Loc _ 8*

city centre [] suburban []

village or small town centre []

health centre [] within hospital []

supermarket "in-store" [] other (please specify) []

3. From which socio-economic group do the majority of your pharmacy's patients and customers come? *SEG _ 9*

AB (middle class, professional, managerial) []

C1 (white collar workers) []

C2 (skilled working class) []

DE (semi or unskilled, those relying on social security or state pension) []

Unable to classify, broad cross-section of the above []

4. What is the average number of total prescription items dispensed in the pharmacy each week? *Ite _ 10*

0-199	[]	200-399	[]
400-599	[]	600-799	[]
800-999	[]	1000-1199	[]
1200-1399	[]	1400+	[]

SECTION B: THE PHARMACIST

5. What is the status of the pharmacist in charge of the pharmacy? *Sta _ 11*

individual proprietor	[]	partner	[]
superintendent	[]	manager	[]
locum	[]	other (please specify)	[]

6. Is the pharmacist in charge male or female? *Sex _ 12*

male	[]	female	[]

7. What is the year of registration of the pharmacist in charge? *Yr _ 13*

1986-1990	[]	1981-1985	[]
1976-1980	[]	1971-1975	[]
1966-1970	[]	1961-1965	[]
1956-1960	[]	1955 or earlier	[]

8. To the nearest full-time equivalent, how many pharmacists are normally practising in your pharmacy at any one time? *Fte _ 14*

1	[]	1.5	[]
2	[]	2.5	[]
3	[]	more than 3	[]

SECTION C: ATTITUDES TOWARDS PATIENT MEDICATION RECORDS

Please tick the statement which best describes your agreement with the following statements.

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
9. The use of PMRs enables the community pharmacist to fulfil a more clinical role.	[]	[]	[]	[]	[]	*Att001 _ 15*
10. The use of PMRs enhances the professional status of the pharmacist.	[]	[]	[]	[]	[]	*Att002 _ 16*
11. The use of PMRs wastes pharmacist time	[]	[]	[]	[]	[]	*Att003 _ 17*
12. The use of PMRs saves ancillary staff time.	[]	[]	[]	[]	[]	*Att004 _ 18*
13. On balance, PMRs give a financial benefit t. the pharmacist	[]	[]	[]	[]	[]	*Att005 _ 19*

SECTION D: USE OF PMR SYSTEMS

14. Does your pharmacy maintain a PMR system? YES [] *Use _ 20*

NO []

If YES, which type? manual []

computer-held []

"smart card" []

If NO, are you planning to set up a PMR system?

Yes []

No []

Possibly []

If your answer to question 14 was yes, please continue with question 15. If your answer to question 14 was no, please go straight to question 39.

15. When did you install your current PMR system? *Ins _ 21*

1990 [] 1989 []

1988 [] 1987 []

1986 or earlier []

16. If you use a computerized PMR who is the program supplier? *Sup _ 22*

Park Systems []

John Richardson []

AAH (Vestric) []

Hadley-Hutt (PILLS) []

Image Microsystems []

In-house system []

Other (please specify) []

17. How many patient records are currently held in the record system? *Pno _ 23*

0-499 [] 500-999 []

1000-2499 [] 2500-4999 []

5000 or more [] Don't know []

18. Where is your PMR computer keyboard situated? *Sit _ 24*

Dispensary []

Reception/Counselling area []

Medicines counter []

Elsewhere (please specify) []

19. Who normally uses the PMR computer keyboard to initiate a patient record? *Ope _ 25*

Pharmacist []

Dispensing assistant []

Other assistant []

SECTION E: DETAILS OF PMRs RELATING TO PATIENTS

20. Do you enter details of previous medication history when initiating a patient's medication record? *His _ 26*

Always [] Usually []

Sometimes [] Never []

If your answer was always, usually or sometimes, how is this achieved?

21. Which of the following patient details do you record routinely on the PMR?

	YES	NO	
surname	[]	[]	*Pat001 _ 27*
first/given name	[]	[]	*Pat002 _ 28*
initials	[]	[]	*Pat003 _ 29*
title	[]	[]	*Pat004 _ 30*
sex	[]	[]	*Pat005 _ 31*
race/nationality	[]	[]	*Pat006 _ 32*
age/date of birth	[]	[]	*Pat007 - 33*
address	[]	[]	*Pat008 _ 34*
telephone number	[]	[]	*Pat009 _ 35*
NHS number	[]	[]	*Pat010 _ 36*
National Insurance number	[]	[]	*Pat011 _ 37*
hospital record number (if applicable)	[]	[]	*Pat012 _ 38*

22. Do you keep records for all your patients?

YES [] NO [] *Pat013 _ 39*

If selective records are maintained which of the following patient groups do you include in your PMR?

all patients living locally	[]	*Pat014 _ 40*
patients over 60	[]	*Pat015 _ 41*
those who have a lot of repeat prescriptions	[]	*Pat016 _ 42*
others (please specify)	[]	*Pat017 _ 43*

23. Are any details of the following included in the PMRs which you hold for your patients?

	YES	NO	
GP's name	[]	[]	*Pat018 _ 44*
GP's address	[]	[]	*Pat019 _ 45*
u GP's computer patient reference number	[]	[]	*Pat020 _ 46*
dentist's name	[]	[]	*Pat021 _ 47*
dentist's address	[]	[]	*Pat022 _ 48*
Family planning clinic	[]	[]	*Pat023 _ 49*
hospital outpatients department	[]	[]	*Pat024 _ 50*
"alternative" practitioners (please specify)	[]	[]	*Pat025 _ 51*

24. Do you include a record of allergies, sensitivities or idiosyncratic reactions to any of the following on the PMR?

	YES	NO	
colour/preservative/flavourings	[]	[]	*All001 _ 52*
salicylates	[]	[]	*All002 _ 53*
penicillin	[]	[]	*All003 _ 54*
NSAIDS	[]	[]	*All004 _ 55*

Please state any other drugs or types of allergen which are recorded in this way.

25. Do you ever note the suitability of child-resistant closures for elderly and arthritic patients or those who are otherwise incapacitated.? *Pat026 _ 56*

YES [] NO []

26. Do you ever record prescription charge exemption for patients? *Pat027 _ 57*

YES [] NO []

27. Do you record any of the following conditions in your patient's records?

	YES	NO	
pregnancy	[]	[]	*Con001 _ 58*
breast-feeding	[]	[]	*Con002 _ 59*
confused	[]	[]	*Con003 _ 60*
asthma	[]	[]	*Con004 _ 61*
diabetes	[]	[]	*Con005 _ 62*
hypertension	[]	[]	*Con006 _ 63*
cardiac disease	[]	[]	*Con007 _ 64*
hepatic impairment	[]	[]	*Con008 _ 65*
renal impairment	[]	[]	*Con009 _ 66*
coeliac disease	[]	[]	*Con010 _ 67*
epilepsy	[]	[]	*Con011 _ 68*
hay fever	[]	[]	*Con012 _ 69*
peptic ulcer	[]	[]	*Con013 _ 70*
Parkinson's disease	[]	[]	*Con014 _ 71*
drug addict	[]	[]	*Con015 _ 72*
HIV positive	[]	[]	*Con016 _ 73*
depression	[]	[]	*Con017 _ 74*
haemophilia	[]	[]	*Con018 _ 75*
skin disorders	[]	[]	*Con019 _ 76*
glaucoma	[]	[]	*Con020 _ 77*
mental handicap	[]	[]	*Con021 _ 78*
physical handicap	[]	[]	*Con022 _ 79*
cystic fibrosis	[]	[]	*Con023 _ 80*
arthritis	[]	[]	*Con024 _ 1*
others (please specify)	[]	[]	*Con025 _ 2*

Num _ 3-4

28. How do you amend your PMR if a patient dies? *Pat028 _ 5*

Do nothing []

Archive record on computer []

Print and retain record []

Delete all patient details []

29. What action do you take if a patient leaves the area? *Pat029 _ 6*

Make a note in the PMR []

Give a printout of PMR to patient []

Supply a printout of PMR to another pharmacy with patient's permission []

None of the above []

30. Do you ever include the following details about patients in your PMR?

	YES	NO	
occupation	[]	[]	*Pat030 _ 7*
smoking habits	[]	[]	*Pat031 _ 8*
alcohol consumption	[]	[]	*Pat032 _ 9*
height/ weight	[]	[]	*Pat033 _ 10*

31. Do you include results from any of the following diagnostic tests in your PMR?

	YES	NO	
In-pharmacy blood pressure readings	[]	[]	*Pat034 _ 11*
In-pharmacy serum cholesterol level	[]	[]	*Pat035 _ 12*
In-pharmacy pregnancy test results	[]	[]	*Pat036 _ 13*

32. Do patients ever ask to see their records as provided for under the Data Protection Act 1984? *Pat037 _ 14*

Often []

Rarely []

Never []

33. Are patients ever reminded about their rights to access their record? *Pat038 _ 15*

YES [] NO []

SECTION F: DETAILS OF PMRs RELATING TO PRODUCTS

34. Do you ever use the PMR to record sales of OTC medicines to patients on your PMR system? *Pro001 _ 16*

NO []

Counter-prescribed medicines only []

All purchased medicines []

35. Which of the following details are recorded for dispensed medicines in the PMR?

	YES	NO	
name of drug prescribed	[]	[]	*Pro002 _ 17*
strength	[]	[]	*Pro003 _ 18*
dosage form	[]	[]	*Pro004 _ 19*
quantity	[]	[]	*Pro005 _ 20*
dose	[]	[]	*Pro006 _ 21*
date of supply	[]	[]	*Pro007 _ 22*
prescriber's name	[]	[]	*Pro008 _ 23*
type of prescription ie NHS/ private	[]	[]	*Pro009 _ 24*
expiry date	[]	[]	*Pro010 _ 25*
batch number	[]	[]	*Pro011 _ 26*
manufacturer of generic products	[]	[]	*Pro012 _ 27*
product supplier/ wholesaler	[]	[]	*Pro013 _ 28*
formulae for extemporaneously dispensed items	[]	[]	*Pro014 _ 29*

36. Do you ever use your PMR to prevent excess medication from being dispensed to patients on repeat prescription (Eg. 100 tablets prescribed every 28 days on a tds dose)? *Pro015 _ 30*

Often []

Rarely []

Never []

37. Are any of the following details recorded about dressings and appliances?

	YES	NO	
type	[]	[]	*Pro016 _ 31*
size	[]	[]	*Pro017 _ 32*
re-order code	[]	[]	*Pro018 _ 33*
normal supplier	[]	[]	*Pro019 _ 34*

38. Are records maintained on the PMR system for patients on oxygen therapy, if oxygen is supplied from your pharmacy? *Pro020 _ 35*

Yes	[]
No	[]
Do not supply oxygen	[]

39. In principle, how do you label medication which is prescribed "as directed", "as before", or where no directions are stated? *Lab _ 36*

Label exactly as per the prescription	[]
consult the patient and label with the directions given	[]
contact the prescriber/receptionist and label with the directions given	[]
label with directions held in the PMR	[]
Other (please specify)	[]

SECTION G: PATIENT INFORMATION LEAFLETS

Some PMR systems produce printed patient information leaflets giving details of drug action, instructions and possible side effects.

40. Do you use this type of system. Yes [] *Lea001 _ 37*

No []

Please tick the statement which best describes your agreement with the following statements.

	Strongly agree	Agree	Feel neutral	Disagree	Strongly disagree	
41. Patient information leaflets reinforce information given to patients by prescribers.	[]	[]	[]	[]	[]	*Lea002 _ 38*
42. Patient information leaflets reinforce information given to patients by pharmacists.	[]	[]	[]	[]	[]	*Lea003 _ 39*
43. Patient information leaflets which give information about side effects may worsen compliance by alarming patients.	[]	[]	[]	[]	[]	*Lea004 _ 40*
44. Patient information leaflets provide a basis for discussion between pharmacist and patient.	[]	[]	[]	[]	[]	*Lea005 _ 41*
45. Pharmacists who issue patient information leaflets are at risk of undermining patients' confidence in their prescriber.	[]	[]	[]	[]	[]	*Lea006 _ 42*
46. More widespread use of patient information leaflets would improve patient compliance.	[]	[]	[]	[]	[]	*Lea007 _ 43*
47. The use of patient information leaflets reassures patients about their medicine	[]	[]	[]	[]	[]	*Lea008 _ 44*

SECTION H: FUTURE RESEARCH

In the next stage of our research, we shall want to find out what pharmacists do with the information that is stored in the PMR and will be looking at how the use of PMRs may improve patient care, by comparing data gathered from pharmacies with and without PMRs.

48. Would your pharmacy be prepared to assist in a further survey involving monthly collection of a limited amount of data about the nature and number of interventions made by pharmacists in connection with prescribed and counter-prescribed medication? The record sheet will not be complicated or time-consuming to complete.

Yes [] *Fur _ 45*

No []

I Would like more information []

Thank you very much for your kind co-operation with this survey. If you have any further comments on this survey or on how you use PMRs, we would be very grateful if you could write them below.

Philip J Rogers
George Fletcher
John E Rees

Pharmacy Practice Research Unit
School of Pharmacy and Pharmacology
University of Bath
Claverton Down
Bath BA2 7AY

Follow-up Questionnaire Sent to Pharmacies Which had Installed a PMR System During 1990

Pharmacy Practice Research Unit
School of Pharmacy and Pharmacology
FREEPOST (SN1548)
University of Bath
Bath BA2 7LZ

Patient Medication Records (PMRs) in Community Pharmacy

id _____

Please rate each of the following reasons for purchasing a PMR system on a scale of 1 (very important) to 5 (very unimportant / not relevant).

	<Very Important 1	2	3	4	*Very Unimportant / Not Relevant>* 5
Availability of NHS remuneration					
Competition from other pharmacies					
Head office policy					
Necessary to update computer equipment					
Need to provide an improved clinical service					
Sales promotion					
To enhance working relationship with GPs/ receptionists					
To keep abreast of professional changes					
Other reasons (please state)					

How do you rate your current system on a scale of 1 (excellent) to 5 (poor): _____

Are there any features which you would like as a part of your PMR system, which your current system does not have?

Please return this form in the enclosed FREEPOST envelope.
Thank you for your cooperation.

PILLS User Survey January 1993.

PHARMACY PRACTICE RESEARCH UNIT
SCHOOL OF PHARMACY AND PHARMACOLOGY
UNIVERSITY OF BATH
CLAVERTON DOWN
BATH BA2 7AY

PATIENT MEDICATION RECORDS IN COMMUNITY PHARMACY

This questionnaire should be completed by the pharmacist normally in charge of the pharmacy.

All answers will be treated in the strictest confidence and will not be disclosed to any third party under any circumstances

Please tick one box for each question unless otherwise specified.

SECTION A: THE PHARMACY

1. When was your *PILLS* system installed?

   1987 or before [ ] 1988 [ ] 1989 [ ]

   1990 [ ] 1991 [ ] 1992 [ ]

2. Do you use the *PILLS* multi-user system? Yes [ ] No [ ]

3. How would you describe the location of your pharmacy

   city centre [ ] suburban [ ] village or small town centre [ ]

   health centre [ ] within hospital [ ] supermarket "in-store" [ ]

   other [ ], please specify _____

4. From which socio-economic group do the majority of your pharmacy's patients and customers come?

   AB (middle class, professional, managerial) [ ] C1 (white collar workers) [ ]

   C2 (skilled working class) [ ]

   DE (semi or unskilled, those relying on social security or state pension) [ ]

   Unable to classify, broad cross-section of the above [ ]

5. What is the year of registration of the pharmacist in charge of the pharmacy?

   1991-2 [ ] 1986-1990 [ ] 1981-1985 [ ]

   1976-1980 [ ] 1971-1975 [ ] 1966-1970 [ ]

   1961-1965 [ ] 1956-1960 [ ] 1955 or earlier [ ]

SECTION B: PATIENTS' CLINICAL CONDITIONS

6. How many patient records are on file in your system? _____

This number is obtained by typing /Q at the patient name prompt, followed by your file access code. The required information is then presented on-screen.

NB. This information is needed to compare percentages of patients with various conditions between different types of pharmacy, parts of the country etc.

7. Do you record any patient conditions or drug allergies in your *PILLS* system?

Yes [ ] No [ ]

If your answer to question 7 was **No**, there is no need to complete question 8. If you answered **Yes** to question 7, please complete question 8.

8. How many patients are recorded as having each of the conditions listed in the table below?

This information is obtained by typing /PF at the patient name prompt, followed by D and the code given with each listed condition.

Condition	Code	Number of patients
AIDS	$AIDS	_____
Alcoholism	$ALCO	_____
Angina	$ANGI	_____
Asthma	$ASTH	_____
Atopic dermatitis	$ATOP	_____
Bradycardia	$BRAD	_____
Bronchitis	$BRON	_____
Colitis	$COLI	_____
Constipation	$CONS	_____
Diabetes	$DIAB	_____
Drug dependence	$DRUG	_____
Eczema	$ECZE	_____
Epilepsy	$EPIL	_____
Eye Problems	$EYEP	_____
Hay fever	$HAYF	_____
Haemophilia	$HAEM	_____
Heart failure	$HEAF	_____
Hypertension	$HYPE	_____
Hyperthyroidism	$HYPT	_____

Continued on next page.

Condition	Code	Number of patients
Kidney disease	$KIDN	_____
Lactation	$LACT	_____
Livsr disease	$LIVF	_____
Mental illness, severe	$MENS	_____
Migraine	$MIGR	_____
Parkinson's disease	$PARK	_____
Pregnancy	$PREG	_____
Psoriasis	$PSOR	_____
Smoker	$SMOK	_____
Stomach ulcer	$STOM	_____

Please list any other conditions from leaflet number 523 (copy on page 4) which are regularly recorded in your system.

Thank you very much for your kind co-operation with this survey. If you have any further comments on the survey, the *PILLS* system, or on how you use PMRs, we would be very grateful if you could write them below.

Philip J Rogers
George Fletcher
John E Rees

Leaflet no: 523. CONDITIONS

At this pharmacy, as you know, we have one of the most advanced computer systems in use in any pharmacy in the country. We make a computer record of each and every prescription medication which we dispense for you. This is repeated for each occasion that you bring a prescription to us for dispensing. All records are of course treated in complete confidence, as required by the Royal Pharmaceutical Society and the data protection act. Access to the computer is only allowed to our pharmacist and dispenser.

One of the benefits of keeping records is that we can check that the medicine can be safely taken by you. Some people have a medical condition or illness that makes it unwise to take some medicines. It will help us check for this if you underline any of the following conditions that you have so that your record can be altered.

Some of the conditions will be very strange to you. Do not worry if you do not understand them, because if they did apply to you you would have been told by your doctor. If you require any help or advice, speak to the pharmacist.

Some of the conditions will only apply for a time, for example if you are pregnant or breast feeding. When they no longer apply you should tell your pharmacist who will then alter your record.

327

Achlorhydria	Addison's disease	Agitation
AIDS	Alcoholism	Anaemia (severe)
Angina	Arteriosclerosis	Asthma
Atopic dermatitis	A V block (conduction problems in heart)	
Bleeding problems	Blood disorders	Blood vessel disease
Bone marrow depression	Bradycardia (slow heart beat)	
Brain disorders	Breast cancer in men	Breast cancer
Bronchitis	Cervical cancer	Chickenpox
Children under 12	Colitis	Constipation
Dehydration (severe)	Depression	Diabetes
Down's syndrome	Drug dependence	Dry mouth
Eczema	Electrolyte deficiency	Emphysema
Endometriosis	Epilepsy	Eye problems
Fibrostatic breast disease		Gall stones
Gout	Guillain-Barre syndrome	Haemochromatosis
Haemophilia	Haemorrhoids	Haemosiderosis
Hay fever	Headache (severe or frequent)	
Heart disease	Heart failure	Hypercalcaemia
Hyperkalaemia	Hypertension	Hyperthyroidism
Hypochlorhydria (low stomach acid)		Hypothyroidism
Infection (severe)	Intestinal problems	
Jaundice (pregnancy or drugs)		Kidney disease
Kidney stones	Lactation (breast feeding)	
Leukemia	Liver disease	Lung disease
Manic depression	Mental illness, severe	Mental or emotional problems
Migraine	Myaesthenia gravis	Nerve or brain disease
Oedema	Oesophagitis	Optic neuritis
Osteoporosis	Ovarian cysts	Over 40 years of age
Pacemaker fitted	Parkinson's disease	Phaeochromocytoma
Phenyketonuria	Polymyalgia rheumatica	Porphyria
Pregnancy	Prostate cancer	Prostate enlargement
Psoriasis	Raynaud's syndrome	Rectal irritation/bleeding
Sarcoidosis	Schizophrenia	Scleroderma
Shingles	Sickle cell anaemia	Smoker
Spastic paralysis (children)		Stomach ulcer
Stroke	Surgery, major, expected	
Systemic lupus erythaematosus		Temporal arteritis
Thromboembolism	Thrombophlebitis	Thrombosis
Thyroid function impairment		Tourett's syndrome
Toxaemia in pregnancy	Urination difficulty	Vaginal bleeding abnormal
Vascular surgery	Wolff-Parkinson-White syndrome	
Xanthine oxidase deficiency		

When you have underlined conditions that apply to you, please fill in the part of the form below and hand to the pharmacist.

SURNAME ..... Forenames .....

DATE OF BIRTH (For a child under 13 only): .....

ADDRESS .....

.....

.....

Printed: 12.11.1993

The Pharmacy University of Bath

Antibiotic Compliance Questionnaire (February 1992)

Dear Patient

This questionnaire is part of a survey being undertaken onx how patients take antibiotics. It is totally anonymous, since no personal details are recorded. Please do take a couple of minutes to complete the questions below and return the questionnaire in the attached FREEPOST envelope. Do not place any postal stamps on the envelope.

For questions 1 and 2 the information can be found on your medicine label.

1. What is the name of your antibiotic? [ ]

2. How many doses were supplied?
   Number of capsules [ ]
   Number of tablets [ ]
   Number of ml of liquid [ ]

3. Did you take the whole course of medicine? Yes [ ] No [ ]

If your answer to question 3 was *yes*, please go straight to question 6. If your answer was *no*, please continue with question 4.

4. If you did not take the whole course, was this because of:
   Side-effects [ ]
   Feeling better [ ]
   Any other reason (please state below) [ ]

5. How much was left when you finished your antibiotics?
   Number of tablets [ ]
   Number of capsules [ ]
   Approximate amount of liquid [ ]

6. When did you take your antibiotic?
   With or after food [ ]
   On an empty stomach [ ]
   At your convenience [ ]

7. Did you experience any of the following side-effects, while taking your antibiotic?

Rash	[ ]	Sickness	[ ]	Diarrhoea	[ ]
		Headache	[ ]	Indigestion	[ ]
Dizziness	[ ]	Others (please state below)			[ ]

8. Please list any other medicines you were taking at the same time as your antibiotic.

9. Are you male [ ] or female [ ]?

10. How old are you?

15-24	[ ]	15-34	[ ]	35-44	[ ]	45-54	[ ]
		55-64	[ ]	65-74	[ ]	75+	[ ]

11. Did you receive a leaflet with your antibiotic? Yes [ ] No [ ]

12. If yes did you read and understand it? Yes [ ] No [ ]

Thank you for completing this questionnaire.

Survey of Pharmacy Computer Systems Used in North America (June 1992).

Please complete and return to: Philip J Rogers
Teacher-Practitioner
School of Pharmacy and Pharmacology
University of Bath
Claverton Down
BATH BA2 7AY
United Kingdom

As part of a research project investigating the international use of pharmacy computer systems, we would be most grateful if you could provide the following information about your Company's system.

System Supplier: System Name:

Please tick one box for each question, unless otherwise stated.

Section A: Database and Coding Information

How would you describe the database(s) used within your system? *Flat file* [ ]
Relational [ ]
Other / don't know [ ]

Who is the owner / supplier of the database used within your system? *First DataBank* [ ]
Medi-Span [ ]
Produced in-house [ ]
Other, please specify [ ]

Are any of the following external coding systems used? *ICD-9* [ ]
ICD-10 [ ]
READ [ ]
Other (please specify) [ ]

Section B: Drug and Product Information

Does your system provide information about drug dosage, including paediatric and geriatric dosing?
Yes [ ] *No* [ ]

Is information provided on adverse drug reactions (ADRs)?
Yes [ ] *No* [ ]

If *yes*, which of the following are provided?
Severity of ADR, eg. major / minor *Yes* [ ] *No* [ ]
ADR incidence *Yes* [ ] *No* [ ]
Signs and symptoms of ADR *Yes* [ ] *No* [ ]
Differentiation of allergies, overdose and toxic effects
Yes [ ] *No* [ ]

Section C: Drug Interactions

Does your system monitor prescription records for the possibility of drug-interactions?
Yes [ ] *No* [ ]
If *yes*, how many levels of significance are provided? [ ]

Is information provided about the possible effect of a particular drug interaction?
Yes [ ] *No* [ ]

Who provides the drug interaction information for your system? *First DataBank* [ ]
Medi-Span [ ]
Produced in-house [ ]
Other, please specify [ ]

Are references given for drug interactions? *Yes* [ ] *No* [ ]

If *yes*, which of the following sources are used?

Hansten	[ ]
Stockley	[ ]
USP DI	[ ]
Martindale	[ ]
Drug manufacturer	[ ]
Other, please specify	[ ]

_____

Section D: Patient Information

Does your system have a facility to record a particular patient's medical conditions?
Yes [ ] *No* [ ]

If *yes*, does the patient database cross-reference with the drug database to warn pharmacists when drugs are prescribed for patients, for whom they are contra-indicated or inappropriate?
Yes [ ] *No* [ ]

Are different levels of severity shown? *Yes* [ ] *No* [ ]

Does your system allow users to record drug allergies?
Yes [ ] *No* [ ]

Can the results of clinical tests, eg. serum cholesterol, be recorded?
Yes [ ] *No* [ ]

Does your system provide information leaflets

a)	with dispensed medicines	*Yes*	[ ]	*No*	[ ]
b)	about common medical conditions	*Yes*	[ ]	*No*	[ ]

Section E: Residential Care Services

Does your system feature the following for use by consultant pharmacists within residential nursing homes?

a)	drug regimen review	*Yes*	[ ]	*No*	[ ]
b)	drug utilisation review	*Yes*	[ ]	*No*	[ ]

Section F: Management Information

Are the following facilities provided by your system?

Stock control / automatic stock ordering	*Yes*	[ ]	*No*	[ ]
Drug usage enquiry, eg. by doctor	*Yes*	[ ]	*No*	[ ]
Prescription costing	*Yes*	[ ]	*No*	[ ]

Please use the space below to note any other major features of your Company's system which have not been covered by the above questions.

Thank you for taking the time to complete this questionnaire, the results from which will help us determine the variety of use of pharmacy computer systems in North America.

Clinical Intervention Sheet With Example Entries

PHARMACY PRACTICE RESEARCH UNIT
SCHOOL OF PHARMACY AND PHARMACOLOGY
UNIVERSITY OF BATH
CLAVERTON DOWN
BATH BA2 7AY

CLINICAL INTERVENTION EVENT RECORD SHEET

ID No. Period:

DATE	INTERVENTION CATEGORY	DRUG(S) INVOLVED	PATIENT GROUP	PMR USE Y / N	NOTES/ ACTION
28/1/92	**C1**	**Propranolol**	**A**	**Y**	**Phoned GP to alter to Bendrofluazide**
30/1/92	**M2**	**Digoxin 0.25mg Tabs**	**C**	**Y**	**Patient should have had 0.125mg Tabs**
1/2/92	**C2**	**Hyoscine**	**O**	**Y**	**Patient with glaucoma requested Sea Legs**

DATE	INTERVENTION CATEGORY	DRUG(S) INVOLVED	PATIENT GROUP	PMR USE Y / N	NOTES/ ACTION

Notes:

INTERVENTION CATEGORIES

C1 Contraindicated prescribed drug
C2 Contraindicated OTC drug
E Emergency supply of prescription-only medicine
I1 Drug interaction between two drugs on presented prescription
I2 Interaction between drug on presented prescription and drug previously dispensed
I3 Drug interaction with OTC medicine
M1 Prescription error-incorrect drug on presented prescription
M2 Prescription error-incorrect strength on presented prescription
M3 Prescription error-incorrect dose on presented prescription
M4 Prescription errors incomplete/incorrect patient details eg. Mr Jones Tablets on Mrs Jones' prescription

"AT-RISK" PATIENT GROUPS

A Asthmatic
B Breast-feeding
C Cardio-vascular disease inc. cardiac failure, hypertension, clotting disorders
D Diabetic
E Expectant mothers, pregnant
F Fits, epileptic
G Geriatric, elderly patients
H Hepatic impairment
I Immuno-suppressed
M Mentally ill, psychiatric
O Ophthalmic disorders, eg. glaucoma
P Parkinson's disease
R Renal impairment

S Skin diseases
T Thyroid patients
U Peptic Ulcer
Y Young patient (paediatric)

N Not listed above, miscellaneous

A Survey of General Medical Practitioners' Views on Primary Care Patient Medication Records (April 1993)

We would be most grateful if you could complete this questionnaire and return it to us in the enclosed Freepost envelope. All individual responses will be treated in the strictest confidence and will not be disclosed to a third party under any circumstances.

Please tick one box for each question unless otherwise specified.

SECTION A: YOUR PRACTICE

1. How would you describe the location of your practice?

City centre [ ] Suburban [ ] Small town [ ]

Rural [ ] Other, please specify [ ]

2. Is your practice fund-holding? Yes [ ] No [ ]

3. Is your practice a dispensing practice? Yes [ ] No [ ]

4. What was your year of registration as a doctor?

1952 or earlier [ ] 1953-62 [ ] 1963-72 [ ]

1973-82 [ ] 1983-92 [ ]

SECTION B: PRACTICE COMPUTERISATION

5. Is your practice computerised? Yes [ ] No [ ]

If your answer to question 5 was Yes please continue with question 6. If your answer was No please go straight to question 8.

6. For which of the following do you use your computer system?

Monitoring for potential drug interactions? Yes [ ] No [ ]

Viewing of clinical data on patients during consultation

Yes [ ] No [ ]

Viewing of clinical data on drugs during consultation

Yes [ ] No [ ]

7. Does your practice computer have a modem and software, enabling on-line communication to other computer systems?

Yes [ ] No [ ]

SECTION C: HOLDING OF MEDICATION RECORDS IN PRIMARY CARE

Who do you think should hold patients' medication records?
Please tick relevant box(es) if you agree.

FHSAs [ ] Patients [ ] Pharmacists [ ]

Prescribers [ ] Other(s), please specify [ ]

Planned integration of computer systems within the NHS may lead to FHSAs, or another authority, being able to provide a record database from which practitioners can *selectively* gain access to patient record data, which they need to execute their role. Which of the following professionals, in contract with FHSAs, do you feel should be permitted to do this?
Please tick relevant box(es) if you agree.

Community pharmacists [ ] Dentists [ ] General practitioners [ ]

Ophthalmic opticians [ ] Other(s), please specify below [ ]

SECTION D: PHARMACY-HELD PATIENT MEDICATION RECORDS

Current research shows that about 70% of community pharmacies maintain patient medication records. Since patients are free to have prescriptions dispensed at the pharmacy of their choice, many pharmacy-held patient medication records will be only partially complete. Registration with a pharmacy, selected by and convenient to the patient would enable more comprehensive records to be maintained. Do you think that patient registration with one pharmacy would be beneficial for?

All patients [ ]

Selected groups of patients, with chronic conditions [ ]

No patients [ ]

Pharmacists are encouraged, through the receipt of a small NHS fee, to maintain records for two groups of patients: the elderly and the confused. A few pharmacies maintain records only for these patient groups; however, most pharmacies will maintain records for patients with a much wider range of conditions. For which of the following patient groups should pharmacists maintain medication records?
Please tick relevant box(es) if you agree that pharmacists should keep medication records for:

Asthmatics [ ] Confused patients [ ] Diabetics [ ]

Elderly [ ] Epileptics [ ] HIV + / AIDS patients [ ]

Ostomy patients [ ] Patients with a history of peptic ulceration [ ]

Patients having experienced drug allergies or major adverse reactions [ ]

Patients with cardiac disorders and/or hypertension [ ]

Patients with renal or hepatic impairment [ ]

Please list any other groups of patients, for whom you feel pharmacists should keep medication records.

12. Many pharmacists use computer packages that facilitate the recording of patients' clinical conditions, enabling the monitoring of patients for contraindicated medication, for example non cardio-selective beta-blockers in asthmatic patients. Do you think that community pharmacists should include the recording of clinical conditions as part of their patient medication record profiles?

Yes [ ] No [ ]

If your answer to question 12 was No, please go straight to question 14. If your answer was Yes, please continue with question 13.

13. If pharmacists are to incorporate clinical conditions into patient records, how do you think that this should be achieved?

By inference, using patients' medication profiles [ ]

Asking patients, using a confidential questionnaire form [ ]

Through formal contact with GP and/or practice staff, with assurance of confidentiality [ ]

Other, please specify [ ]

14. Some pharmacists use computer systems that produce patient information leaflets at the time of dispensing a prescription, an example of which is enclosed. The purpose of the leaflet is to reinforce counselling given to patients by prescribers and/or pharmacists, and to provide additional information on the correct use and potential side effects of prescribed products.

Do you feel that pharmacists should provide additional product information to patients in this way?

Yes [ ] No [ ]

Do you consider that the use of such patient information leaflets :

Improves patient compliance [ ] Has no effect on compliance [ ]

Worsens patient compliance [ ] I am not sure [ ]

15. Some pharmacists record the supply of non-prescription medicines as part of a patient's medication profile. Do you think that this should be normal practice for:
Please tick relevant box(es)

All non-prescription medicines [ ]

Medicines recently declassified from Prescription Only Medicines to Pharmacy Medicines, e.g. vaginal imidazoles, Hydrocortisone 1% cream [ ]

All patients [ ]

Certain patient groups only [ ]

This should not be part of the community pharmacist's role [ ]

SECTION E: DRUG INTERACTIONS

16. Most patient medication record computer systems used in community pharmacies provide information about potential drug interactions. Depending on circumstances, pharmacists will either inform the prescriber of the interaction, counsel the patient, assess the interaction as clinically insignificant, or ascertain that the patient has previously taken an interacting drug combination without noticeable adverse effect.

Do you welcome information about potential drug interactions from pharmacists?

Always [ ] Often [ ] Sometimes [ ]

Seldom [ ] Never [ ]

17. Which reference source(s) would you normally use if you suspected a possible drug interaction?

ABPI Data Sheet Compendium [ ] British National Formulary [ ]

Drug Interactions, (Stockley) [ ] Local community pharmacist [ ]

Hospital pharmacy / district drug information centre [ ] MIMS [ ]

Regional drug information centre [ ] Your practice computer system [ ]

Other(s), please specify below [ ]

18. Research has shown that there is considerable variation between lists of potential interactions provided by various computer systems used in medical and pharmaceutical practice, arising from the use of different reference sources and clinicians' opinions. Do you think that the interaction information given by the BNF should be taken as the usual standard reference source in primary care?

Yes [ ] No [ ]

If the BNF is not acceptable as a standard reference source for drug interactions, which of the above (Q.17) or other sources should be considered a standard reference.

Thank you very much for your co-operation with this survey. If you have any further comments on the use of patient medication record systems, we would be most grateful if you could write them below.

Philip J Rogers
George Fletcher
John E Rees

Pharmacy Practice Research Unit
School of Pharmacy and Pharmacology
University of Bath

Appendix 3. Clinical interventions associated with drug interactions between newly-prescribed and previously-dispensed medicines.

Drug affected	Interacting drug	Outcome
Frusemide	Co-amilofruse	Frumil deleted from new Rx for Lasix + Capoten
Phenytoin	Cimetidine	Alter to ranitidine
Aminophylline	Erythromycin	Altered to flucloxacillin
Atenolol	Diltiazem	Aminophylline added
Burinex K	Cephalexin	Ceporex discontinued
Migril	Erythromycin	Change to Oxytetracycline
Salbutamol	Co-tenidione	Changed to Adalat Retard
Aminophyline	Ciprofloxacin	Changed to Co-trimoxazole
Parstelin	Lomotil	Changed to Dioralyte
Carbamazepine	Ciprofloxacin	Changed to Distaclor. Ciproxin prev. disp. elsewhere!
Theophylline	Ciprofloxacin	Changed to Magnapen
Theophylline	Cimetidine	Cimetidine dose reduced
Captopril	Co-amilofruse	Frumil changed to frusemide
Captopril	Co-amilofruse	Frumil changed to frusemide
Captopril	Ketoprofen	Ibuprofen gel used instead
Enalapril	Diclofenac	Innovace dose reduced
Co-tenidione	Nifedipine	Nifedipine discontinued
Co-amilozide	Lithium	Patient to have blood test
Warfarin	Mefanamic acid	Ponstan not dispensed
Cisapride	Cisapride	Prepulsid & Alimix both prescribed
Nifedipine	Prochlorperazine	Prochlorperazine dose reduced
Aminophylline	Ciprofloxacin	Reduce Phyllocontin dose by 50%
Aminophylline	Clarithromycin	Reduced Phyllocontin dose
Atenolol	Nabumetone	Relifex discontinued
Captopril	Slow K	Slow K discontinued
Theophylline	Clarithromycin	Stop Nuelin
Co-proxamol	Paracetamol	Stop paracetamol
Oxprenolol	Pseudoephedrine	Sudafed not supplied. Patient back to surgery
Theophylline	Ciprofloxacin	Theophylline dose reduced
Nifedipine	Verapamil	Verapamil stopped

Appendix 4: Interacting Drug Pairs Reported During the Period August 1991-July 1992. Drug interactions in bold text are discussed in Chapter 8 of the text.

Interacting Drug Pair:				*Published Reference Sources:*					*PMR Computer systems:*			
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Gaviscon	1010101	Oxytetracycline	5010300	Y	Y	Y	No	Y	++	2	Possible	Minor
Gaviscon	1010101	Ciprofloxacin	5011200	Y	Y	Y	No	Y	++	3	Possible	Minor
Gaviscon	1010101	Prednisolone EC	6020100				No					
Gaviscon	1010101	Penicillamine	10010300		Y	Y	No	Y	++	3	Possible	Minor
Cimetidine	1030100	Aluminium hydroxide	1010100			Y?						
Cimetidine	1030100	Atenolol	2040000	Y	Y	Y	Y					
Ranitidine	1030100	Nifedipine	2060200		Y?							
Cimetidine	1030100	Theophylline	3010300	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Cimeditine	1030100	Lorazepam	4010200	Y	Y	Y	Y		+	3		Minor
Cimetidine	1030100	Phenytoin	4080100	Hazardous	Y	Y	Y	Y	+++	1	Probable	Moderate
Digoxin	2010000	Frusemide	2020200	Hazardous	Y	Y	Y	Y	+	]	Probable	Minor
Digoxin	2010000	*Diumide K*	2020800						+	1	Probable	Minor
Digoxin	**2010000**	**Amiodarone**	**2030200**	**Hazardous**	**Y**	**Y**	**Y**	**Y**	**+++**		**Probable**	**Moderate**
Digoxin	2010000	Diltiazem	2060200	Hazardous	Y?		Y	Y	+++	2	Probable	Minor
Digoxin	2010000	Verapamil	2060200	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Digoxin	2010000	Aminophylline	3010300									
Digoxin	2010000	Quinine	5040100	Hazardous	Y				+++	1	Probable	Moderate
Bendrofluazide	2020100	Prednisolone	6030100	Y	Y		Y	Y	+++	2	Possible	Minor
Amiloride	2020200	Enalapril	2050500	Hazardous	Y		Y	Y	+++	2	Probable	Moderate
Bumetanide	2020200	Prednisolone	6030200	Y	Y		Y	Y	+++	3	Possible	Minor
Frusemide	2020200	Prednisolone	6030200	Y	Y		Y	Y	+++	3	Possible	Minor
Frusemide	2020202	Captopril	2050500	Hazardous	Y?	Y	Y		+	2	Probable	Moderate
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*				*PMR Computer systems:*				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Spironolactone	2020300	Lisinopril	2050500	Hazardous	Y		Y	Y	+++	2	Probable	Moderate
Spironolactone	2020300	Lithium	4020300		Y?							
Co-amilozide	**2020400**	**Doxazosin**	**2050400**	**Hazardous**					++		**Probable**	**Minor**
Co-amilofruse	2020400	Captopril	2050500	Hazardous		Y	Y		+++	2	Probable	Moderate
Dyazide	2020400	Indomethacin	10010100	Y	Y			Y	+	2	Possible	Minor
Burinex K	2020800	*Diumide K*	2020800									
Burinex K	2020800	Captopril	2050500	Hazardous?			Y		+	2	Probable	Moderate
Burinex K	2020800	Cephalexin	5010200									
Navidrex K	**2020800**	**Indomethacin**	**10010100**	**Y**	**Y**		**Disc**	**Y**	**+**	**2**	**Possible**	**NA**
Disopyramide	2030100	Erythromycin	5010500	Hazardous	Y				+++	2	Probable	Moderate
Amiodarone	2030200	Warfarin	2080200	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Propranolol	2040000	Amiodarone	2030200	Hazardous	Y	Y			+	2	Probable	Moderate
Propranolol	2040000	Methyldopa	2050200							3	Probable	Minor
Atenolol	2040000	Captopril	2050500	Y?						2	Probable	Minor
Atenolol	2040000	Enalapril	2050500	Y?						2	Probable	Minor
Atenolol	2040000	Diltiazem	2060200	Hazardous					+	1	Probable	Moderate
Atenolol	2040000	Nifedipine	2060200	Hazardous					+	2	□ossible	Moderate
Bisoprolol	2040000	Diltiazem	2060200	Hazardous					+	1	Probable	Moderate
Co-tenidione	2040000	Nifedipine	2060200	Hazardous					+	2	Possible	Moderate
Propranolol	2040000	Nifedipine	2060200	Hazardous					+	2	Possible	Moderate
Propranolol	2040000	Verapamil	2060200	Hazardous	Y	Y	Y	Y	+++		Probable	Moderate
Sotazide	2040000	Salbutamol	3010101						+++	2	Probable	Moderate
Acebutolol	2040000	Pseudoephedrine	3100000	Hazardous					+	2	Probable	Moderate
Atenolol	2040000	Pseudoephedrine	3100000	Hazardous					+	2	Probable	Moderate
Metoprolol	2040000	Pseudoephedrine	3100000	Y					+	2	Probable	Moderate
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*					*PMR Computer systems:*			
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Propranolol	2040000	Chlorpromazine	4020100	Y	Y				+	3	Possible	Minor
Co-tenidione	2040000	Ergotamine	4070401	Y	Y	Y	Y		+++	3	Possible	Moderate
Atenolol	2040000	Indomethacin	10010100		Y	Y		Y	+	2		Minor
Atenolol	2040000	Nabumetone	10010100						+			Minor
Propranolol	2040000	Xylometazoline	12020200	Hazardous						2		Moderate
Methyldopa	2050200	Salbutamol	3010101		Y (iv only)							
Lisinopril	2050500	Pseudoephedrine	3100000	Y?								
Captopril	**2050600**	**Potassium citrate**	**7040300**	**Hazardous**	**Y**	**Y**	**Y**	**Y**	**+++**	**2**	**Probable**	
Enalapril	2050500	***Cymalon***	7040300	Hazardous	Y	Y	Y		NA	NA	NA	
Captopril	2050500	*Slow K*	9020102	Hazardous	Y	Y	Y	Y	+++	2	Probable	
Captopril	2050500	Ketoprofen	10010100	Y	?		Y		+	2	Possible	
Enalapril	2050500	Diclofenac	10010100	Y	Y?		Y		+	2	Possible	
Enalapril	**2050600**	**Allopurinol**	**10010400**		**Y**	**Y**	**Y**	**Y**				
Nifedipine	2060200	Verapamil	2060200									
Diltiazem	**2060200**	**Aminophyline**	**3010300**	**Hazardous**	**Y?**		**Y**		**+++**	**1**	**Probable**	**Moderate**
Verapamil	2060200	Theophylline	3010300	Hazardous	Y?	Y	Y		+++	1	Probable	Moderate
Nifedipine	2060200	Prochlorperazine	4020100	Y?						2	Possible	Minor
Warfarin	2080200	Dipyridamole	2090000	Hazardous	Y	Y			+++	1	Probable	Dangerous
Warfarin	2080200	Bezafibrate	2120000	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Warfarin	2080300	Aspirin	4070100	Hazardous		Y	Y	Y	+++	1	Probable	Dangerous
Warfarin	2080200	Co-proxamol	4070101	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Warfarin	2080200	Carbamazepine	4080100	Hazardous	Y	Y	Y	Y	+++	1	Probable	Moderate
Warfarin	2080200	Erythromycin	5010500	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Warfarin	**2080200**	**Ibuprofen**	**10010100**	**Hazardous?**		**Y**	**?**			**1**	**Probable**	**Moderate**
Warfarin	2080200	Mefenamic acid	10010100	Hazardous		Y	Y		+++	1	Probable	Moderate
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*				*PMR Computer systems:*				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Warfarin	2080200	Phenytoin	4080100	Hazardous	Y	Y	?		++++	2	Probable	Moderate
Salbutamol	3010101	Beclomethasone	3020000	Y?							Possible	
Salbutamol	3010101	*Actifed Co Linctus*	3090200									
Salbutamol	3010101	*Actifed expectorant*	3090200									
Salbutamol	3010101	*Benylin*	3090200									
Aminophylline	3010300	Clarithromycin	5010500						NA	NA	Probable	Moderate
Aminophylline	3010300	Erythromycin	5010500	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Theophylline	3010300	Erythromycin	5010500	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Aminophylline	3010300	Ciprofloxacin	5011200	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Theophylline	3010300	Ciprofloxacin	5011200	Hazardous	Y	Y	Y	Y	++++	1	Probable	Moderate
Mucron	3100000	***Benylin Day & Night***	3100000					NA	NA	NA	NA	NA
Terfenadine	3040000	Erythromycin	5010500				Y				Probable	
Diazepam	4010100	Trimipramine	4030100	Y						3	Possible	Minor
Nitrazepam	4010100	Dothiepin	4030100	Y						2	Possible	Minor
Nitrazepam	4010100	Amitriptyline	4030100	Y						2	Possible	Minor
Nitrazepam	4010100	Imipramine	4030100	Y						2	Possible	Minor
Temazepam	4010100	Amitriptyline	4030100	Y						2	Possible	Minor
Triazolam	4010100	Co-beneldopa	4090100	Y	Y				+	2	Possible	NA
Temazepam	4010100	Griseofulvin	5020000									
Chlordiazepoxide	4010200	Doxepin	4030100	Y						3	Probable	Minor
Lorazepam	4010200	Amitriptyline	4030100	Y						2	Probable	Minor
Lorazepam	4010200	Imipramine	4030100	Y						2	Possible	Minor
Temazepam	4010200	Dothiepin	4030100	Y						2	Possible	Minor
Butobarbitone	4010300	Co-proxamol	4070101									
Haloperidol	4020100	Lithium	4020300	Y		Y	Y		+	2	Possible	Moderate
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*				*PMR Computer systems:*				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Thioridazine	4020100	Amitriptyline	4030100	Y						3	Possible	Minor
Thioridazine	4020100	Co-careldopa	4090100	Y	Y				+++	2	Possible	Minor
Thioridazine	4020100	Oxybutinin	7040200				Y		++	NA	Possible	Minor
Lithium	4020300	Bendrofluazide	2020100	Hazardous	Y	Y	Y	Y	+++	1	Probable	Minor
Lithium	**4020300**	**Paroxetine**	**4030400**	**Hazardous**	**NA**		**Y**		+	**NA**	**Probable**	**Moderate**
Lithium	4020300	Ibuprofen	10010100	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Lithium	4020300	Indomethacin	10010100	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Lithium	4020300	Naproxen	10010100	Hazardous	Y	Y	Y	Y	+++	2	Probable	Moderate
Amitriptyline	4030100	Phenelzine	4030200	Hazardous	Y	Y	Y	Y	+++	1	Probable	Moderate
Dothiepin	4030100	Phenelzine	4030200	Hazardous	Y	Y	Y	Y	+++	1	Probable	Moderate
Trimipramine	4030100	Phenelzine	4030200	Hazardous	Y	Y	Y	Y	+++	1	Probable	Moderate
Dothiepin	4030100	Aspirin	4070100									
Imipramine	4010200	Phenytoin	4080100	Hazardous	Y		Y		+++	2	Probable	Minor
Amitriptyline	4030100	*Cyclo-Progynova*	6040200		Y	Y				3		Minor
Prochlorperazine	4060000	Sodium valproate	4080100	Hazardous?					+++	2	Probable	Minor
Paracetamol	4070100	Co-proxamol	4070101					Y			Possible	Moderate
Paracetamol	4070100	Co-dydrarmol	4070101					Y			Possible	Moderate
Aloxipirin	4070100	Methotrexate	8010300	Hazardous	Y			Y	++++		Probable	Moderate
Co-proxamol	4070101	Benorylate	4070100					Y			Possible	Moderate
Co-dydramol	4070101	Co-codamol	4070101					Y			Possible	Moderate
Co-dydramol	4070101	Co-proxamol	4070101					Y			Possible	Moderate
Co-proxamol	4069781	*Tylex*	4070101					Y			Possible	Moderate
Solpadol	4070101	Codeine phosphate	4070200									
Co-codamol	4070101	*Migraleve*	4070401					Y			Possible	Moderate
Co-proxamol	4070101	*Migravess*	4070401	Y					+	3	Possible	Minor
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*				*PMR Computer systems:*				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Carbamazepine	**4080100**	**Doxycycline**	**5010300**	**Hazardous**	**Y**	**Y**	**Y**		**+++**	**2**	**Possible**	
Co-proxamol	4070101	Carbamazepine	4080100	Hazardous	Y		Y	Y	+++	1	Probable	Moderate
Paramax	4070401	Metoclopramide	4060000	Y					+	3	Possible	Minor
Penicillin V	5010100	*Microval*	7030200		Y			Y			Possible	
Penicillin V	5010101	*Binovum*	7030100		Y			Y		3	Possible	
Penicillin V	5010101	*Brevinor*	7030100		Y			Y		3	Possible	
Penicillin V	5010101	*Dianette*	7030100							3	Possible	
Penicillin V	5010101	*Femodene*	7030100		Y			Y		3	Possible	
Penicillin V	5010101	*Femulen*	7030100		Y			Y			Possible	
Penicillin V	5010101	*Logynon*	7030100		Y			Y		3	Possible	
Penicillin V	5010101	*Minulet*	7030100		Y			Y		NA	Possible	
Penicillin V	5010101	*Trinovum*	7030100		Y			Y		3	Possible	
Penicillin V	5010101	*Microgynon 30*	7030101		Y			Y		3	Possible	
Penicillin V	5010101	*Noriday*	7030200		Y			Y			Possible	
Amoxycillin	5010103	*Brevinor*	7030100	Y	Y			Y	++	3	Possible	
Amoxycillin	5010103	*Femodene*	7030100	Y	Y			Y	++	3	Possible	
Amoxycillin	5010103	*Logynon*	7030100	Y	Y			Y	++	3	Possible	
Amoxycillin	5010103	*Marvelon*	7030100	Y	Y			Y	++		Possible	
Amoxycillin	5010103	*Microgynon 30*	7030100	Y	Y			Y	++	3	Possible	
Amoxycillin	5010103	*Minulet*	7030100	Y	Y			Y	++	NA	Possible	
Amoxycillin	5010103	*Ovranette*	7030100	Y	Y			Y	++	3	Possible	
Amoxycillin	5010103	*Trinordiol*	7030100	Y	Y			Y	++	3	Possible	
Ampicillin	5010103	*Binovum*	7030010	Y	Y	Y		Y	++	3	Possible	
Ampicillin	5010103	*Microgynon 30*	7030100	Y	Y	Y		Y	++	3	Possible	
Co-amoxiclav	5010103	*Minulet*	7030100	Y	Y			Y	++	NA	Possible	
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				Published Reference Sources:				PMR Computer systems:				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Co-amoxiclav	5010103	*Logynon*	7030100	Y	Y			Y	++	3	Possible	
Co-amoxiclav	5010103	*Marvelon*	7030100	Y	Y			Y	++		Possible	
Co-amoxiclav	5010103	*Microgynon 30*	7030100	Y	Y			Y	++	3	Possible	
Co-amoxiclav	5010103	*Microval*	7030100	Y	Y			Y			Possible	
Amoxycillin	5010103	*Femodene*	7030200	Y	Y			Y	++	3	Possible	
Cefaclor	5010200	*Logynon*	7030100			Y				3	Possible	
Cefaclor	5010200	*Logynon ED*	7030100			Y				3	Possible	
Cefaclor	5010200	*Marvelon*	7030100			Y					Possible	
Cefuroxime	5010200	*Binovum*	7030100			Y				NA	Possible	
Cephadrine	5010200	*Microgynon 30*	7030100			Y				3	Possible	
Cephadrine	5010200	*Ovranette*	7030100			Y				3	Possible	
Cephalexin	5010200	*Logynon*	7030100			Y				3	Possible	
Oxytetracycline	5010300	Gliclazide	6010201		Y?			Y				
Doxycycline	5010300	*Femodene*	7030100		Y	Y	Y	Y	++	3	Possible	Minor
Doxycycline	5010300	*Microgynon 30*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Oxytetracycine	5010300	*Trinordiol*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Oxytetracycline	5010300	*Logynon*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Oxytetracycline	5010300	*Microgynon 30*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Oxytetracycline	5010300	*Microgynon 30*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Tetracycline	5010300	□*arvelon*	7030100	Y	Y	Y	Y	Y	++		Possible	Minor
Tetracycline	5010300	*Microgynon 30*	7030100	Y	Y	Y	Y	Y	++	3	Possible	Minor
Detecio	5010300	Ferrous sulphate	9010101	Y	Y	Y	Y	Y	++	2	Possible	Minor
Minocycline	5010300	Ferrous gluconate	9010101	Y	Y	Y	Y	Y	++	2	Possible	Minor
Oxytetracycline	5010300	Ferrous sulphate	9010101	Y	Y	Y	Y	Y	++	2	Possible	Minor
Detecio	5010300	Calcium & Vitamin D	9050101	Y	Y	Y	Y		++	3	Possible	Minor
Key:												
?=unclear		Highest level, where ranked		Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
		Lowest level, where ranked		Y					+		Possble	

Interacting Drug Pair:				*Published Reference Sources:*				*PMR Computer systems:*				
Drug1	**BNF group**	**Drug2**	**BNF group**	**BNF**	**Stockley**	**Martindale**	**Data Sheet**	**Richardson**	**AAH**	**Park**	***PILLS***	**Chemtec**
Oxytetracycline	5010300	Calcium & Vitamin D	9050101	Y	Y	Y	Y		++	3	Possible	Minor
Erythromycin	5010500	*Dianette*	7030100					Y		3	Possible	
Erythromycin	5010500	*Logynon*	7030100		Y			Y		3	Possible	
Erythromycin	5010500	*Marvelon*	7030100		Y			Y			Possible	
Erythromycin	5010500	*Microgynon 30*	7030100		Y			Y		3	Possible	
Co-trimoxazole	5010800	Glibenclamide	6010201	Hazardous	Y	Y	Y	Y	+++	2	Probable	
Co-trimoxazole	5010800	*Logynon*	7030100		Y	Y		Y			Possible	
Co-trimoxazole	5010800	*Microgynon 30*	7030100		Y	Y		Y			Possible	
Trimethoprim	5010800	*Logynon*	7030100		Y			Y		3	Possible	
Trimethoprim	5010800	*Marvelon*	7030100		Y			Y			Possible	
Trimethoprim	5010800	*Microgynon 30*	7030100		Y			Y		3	Possible	
Trimethoprim	5010800	*Minulet*	7030100		Y			Y		NA	Possible	
Metronidazole	5011100	*Minulet*	7030100		Y?			Y		NA	Possible	
Ciprofloxacin	5011200	Etoldac	10010100								Probable	
Nitrofurantoin	5011300	*Minulet*	7030100		Y	Y		Y		NA	Possible	
Disodium etidronate	6060200	Calcium & Vitamin D	9050101	Y			NA		++		Possible	Minor
Methotrexate	8010300	Folic acid	9010200								Possible	
Tiaprofenic acid	10010100	Diclofenac	10010100									
Naproxen	10010100	Diclofenac	10010100									
Yellow Fever Vaccine	14040000	Typhoid Vaccine	14040000					NA	NA	NA	NA	NA
Key:												
?=unclear			Highest level, where ranked	Hazardous					++++	1	Probable	Major
NA=not available on system									+++	2		Moderate
Y=interaction listed									++	3		Minor
			Lowest level, where ranked	Y					+		Possble	

Appendix 5. Business Addresses of Companies Listed in the Text

3PM McKesson Corp.
30881 Schoolcraft
Livonia
MI 48150
USA

AAH *LINK*
Computer Centre
Shaw Road
Speke
Liverpool L24 9NF
England

AAH MEDITEL Ltd
Rigby Hall
Rigby Lane
Bromsgrove
Worcs. B60 2EW
England

Boehringer Ingelheim Ltd.
Ellesfield Ave
Bracknell
Berks RG12 4YS
England

Boots The Chemists Ltd
Thane Road West
Nottingham NG2 3AA
England

Chemtec Systems Ltd
Chemtec House
115 Clydesdale Place
Moss Side
Leyland
Preston
Lancashire PR5 3QS
England

Condor Corporation
Marketing Technical Support
2060 Oak Mountain Drive
Post Office Box 189
Pelham AL 35124
USA

Digital Simplistics Inc
11505 W. 83rd Terrace
Lenexa
KS 66214
USA

Etreby Computer Company, Inc
1240 N. Hacienda Blvd.
La Puente
CA 91744
USA

Exeter Data Base Systems Ltd
2/3 Aldens Business Court
7a Chudleigh Road
Alphington
Exeter EX2 8TS
England

First Data Bank
The Hearst Corporation
1111 Bayhill Drive
San Bruno
CA 94066
USA

General Computer Corporation
2045 Midway Drive
Twinsburg
Ohio 44087
USA

Genisyst Limited
84 Bancroft
Hitchin
Herts SG5 1NQ
England

Hadley Hutt Computing Ltd.
George Bayliss Road
Droitwich
Worcestershire WR9 9RD
England

John Richardson Computers Ltd
St Benedict's House
Brown Lane
Bamber Bridge
Preston PR5 6ZB
England

Lloyds Chemists Plc
Britannia House
Centurion Park
Tamworth
Staffordshire B77 5TZ
England

Medi-span
Woodfield Crossing
Suite 500
PO Box 40930
Indianapolis
IN 46240-0930
USA

M-TEC Computer Services (UK)
Reepham
Norfolk NR10 4JJ
England

Park Systems Ltd
6 Vulcan Street
Liverpool L3 7BG
England

Professional Drug Systems Inc.
530 Maryville Centre Drive
Suite 250
St Louis
MO 63141
USA

QS/1 Data Systems
P.O.Box 6052
8045 Howard Street
Spartanburg, SC 29304
USA

RenLar Systems
2640 Palumbo Drive
Lexington
KY 40500009
USA

Reynadyne Data Systems Inc.
2301 Avenue J
Arlington, TX 76006
USA

Surgichem Ltd.
Surgichem House
Milton Court
Horsfield Way
Bredbury Park Industrial Estate
Bredbury
Stockport SK6 2TD
England

VAMP Health
The Bread Factory
1a Broughton Street
London SW8 3QJ
England